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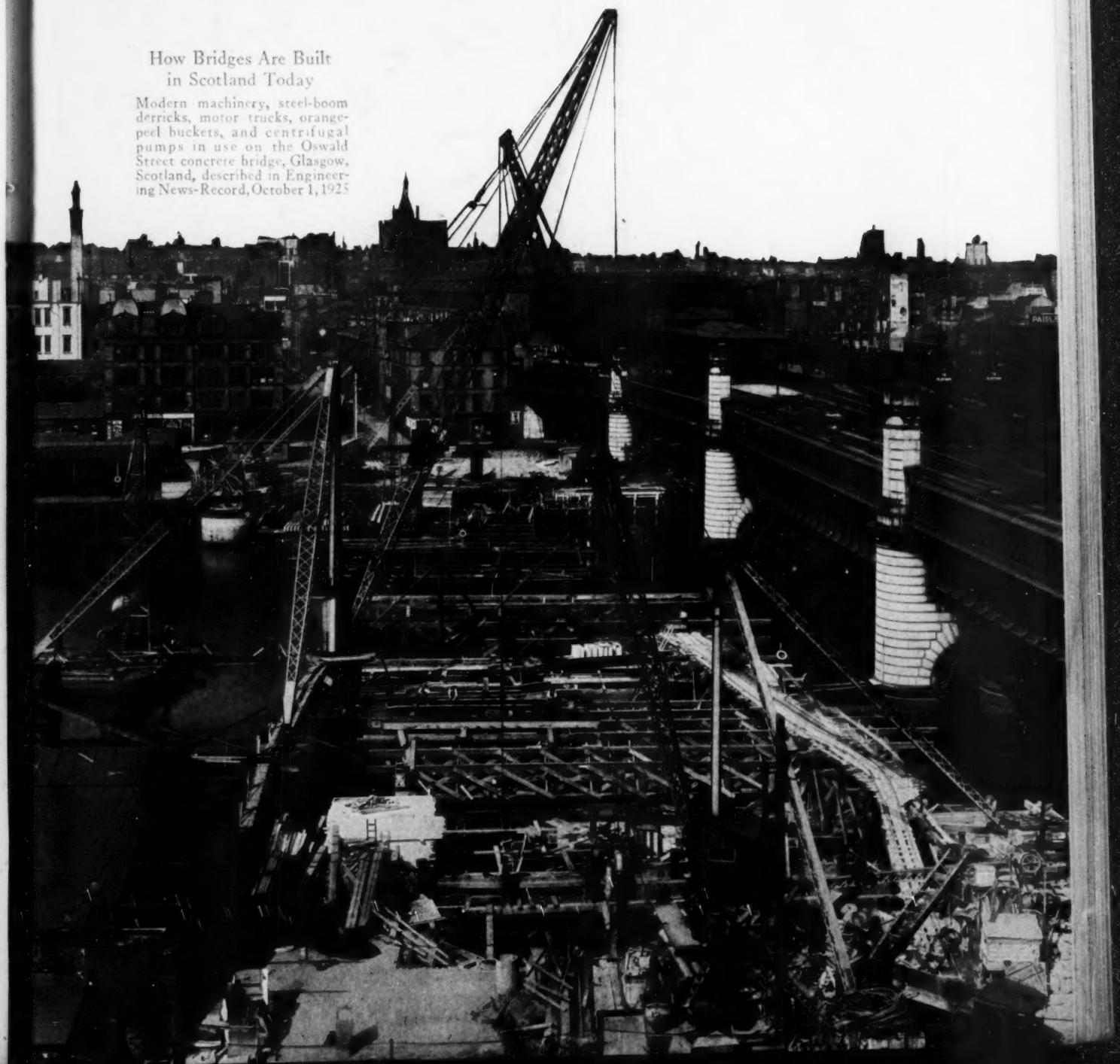
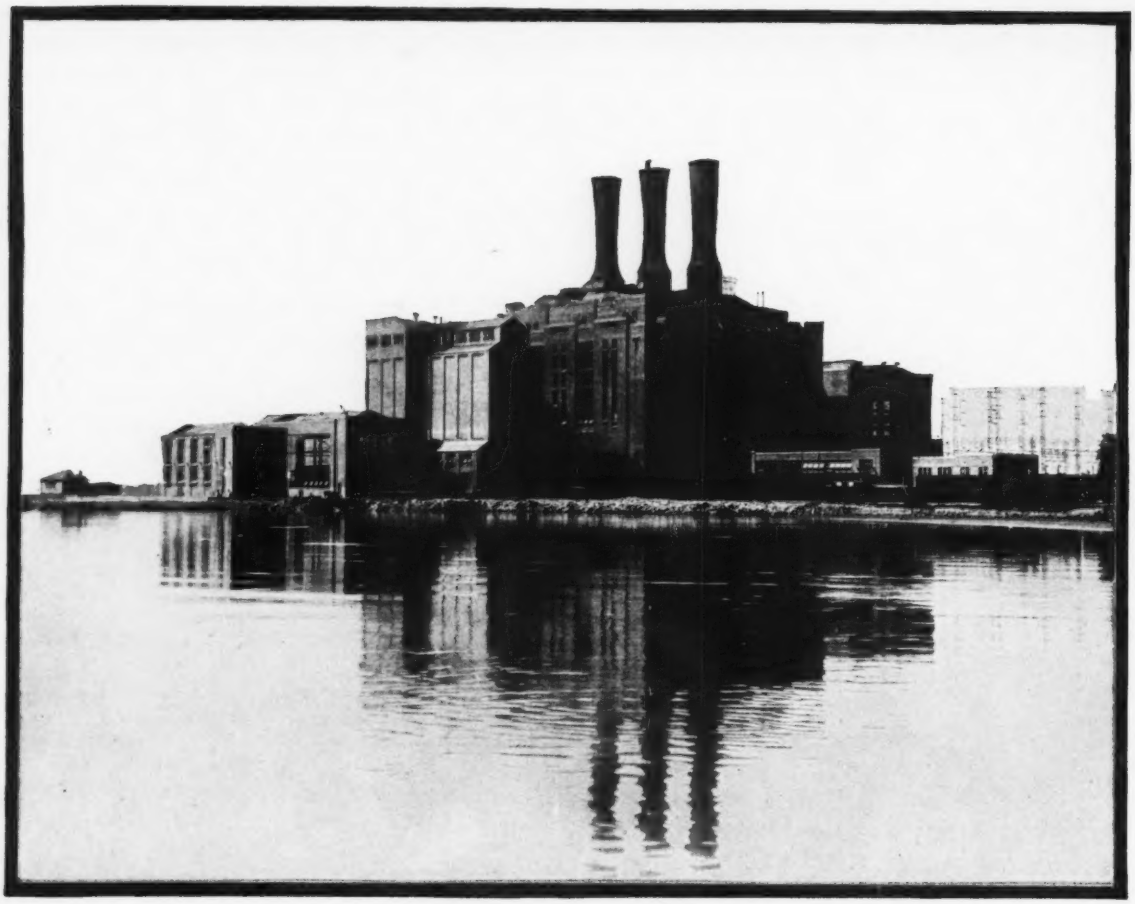
October 29, 1925

Engineering News-Record

How Bridges Are Built in Scotland Today

Modern machinery, steel-boom derricks, motor trucks, orange-peel buckets, and centrifugal pumps in use on the Oswald Street concrete bridge, Glasgow, Scotland, described in Engineering News-Record, October 1, 1925





Roof permanence—no maintenance

TODAY Federal precast reinforced concrete roof slabs are so widely used on all types of industrial and public structures that they must be recognized as the predominant material for both flat and pitched roofs and decks. The reason is that they provide a roof both safe and economical which gives permanent protection without maintenance.

The Detroit Edison Company's Trenton Channel Plant, shown above, is covered with Federal Interlocking Tile and is typical of the many large public utility and industrial plants which are roofed with Federal. Federal Cement Tile are made, laid and guaranteed by the

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ENGINEERING NEWS-RECORD

McGraw-Hill Company, Inc.
JAMES H. McGRAW, *President*
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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 95 | NEW YORK, OCTOBER 29, 1925 | Number 18

Interstate Power Control

ONE group of states has taken the first step toward a solution of the involved problem of interstate power control. Pennsylvania, New Jersey and New York, the composite of the greatest industrial area in the country, have each appointed representatives on what is called a Joint Power Commission. Just what this body can eventually do remains for it to settle, the federal government to approve (or at least to refrain from interference) and the courts to decide—for no one today knows just how far the states can go in the joint control of electric energy that crosses state lines or to just what degree the federal government can or desires to exercise its rights under the interstate commerce provision of the Constitution. However, the three great Middle States purpose to find out, and their representatives will study the joint power requirements and developments and will prepare a compact under which the states can collectively control the interstate utilities to the mutual advantage of the citizens of each state. Interstate compacts are constitutional and of growing value. In this day of reaction away from centralized Washington control of local activities every one may applaud this movement to get together on the perplexing problem of how to restrain, control and develop the activities of the privately owned power corporations whose transmission lines, by proper economical and engineering extension, know no such thing as a state boundary, but whose sources of power and beneficiaries of use are distinctly local.

Public Health Engineering

SANITARY, from its Latin root *sanitas*, is that which pertains to health and a sanitary engineer, by the same token, one who is concerned with the kind of engineering that affects health. But the philological significance of the word is so hazy to the average man that there may be a useful purpose served in calling those who have been known as sanitary engineers by a new name, public health engineer. At least that is what the engineer members of the American Public Health Association who met at St. Louis last week hoped to accomplish by adopting this name. Public health engineering, indeed, extends beyond the field of the old sanitary engineering. That included, generally speaking, only the orthodox subdivisions of water, sewage and garbage; the new term takes in all the other environmental conditions. Thus the public health engineer is concerned with air through control of heating and ventilating and automobile gases; with milk, oysters and other foods through conditioning and control of their distribution; with insect and vermin eradication through mosquito, fly and rat control; with vision through illumination; with town planning, housing and industrial engineering. If the new name will attract students in the engineering schools and do a better job in raising the standing and return of the engineers in public health service, so as to keep men who do get the training, it will be worth the publicity effort necessary to make it well known. The field needs more good men. Conditions become increasingly more complex and health standards more rigid.

Age and Youth

DURING last week an editor of *Engineering News-Record* had occasion to attend two meetings. At one, a succession of practicing engineers, all at least twenty years out of college, asserted that engineering education is becoming mechanized, that the recent graduates are too technical and absorbed too greatly in the details of engineering minutiæ, that they all stand in need of wider outlook and broader background. The other meeting was a group of the editors and business managers of a score of the magazines published by the undergraduates of engineering schools. Throughout a busy day's session these young men discussed the problems of their avocation. And from a long experience in attending technical meetings this editor can say that never has he heard more direct, confident, precise and clear speech than these same undergraduates used. What each had to say he said explicitly and stopped; repetition was rare, hesitation was nonexistent. Can as much be said of the average engineering meeting? Emphatically, no! And since the ability to think clearly and to express that thought succinctly is one of the best outward evidences of those qualities the engineers in the mature meeting found lacking in their younger brethren, the thought became inescapable that these gentlemen—who, indeed, were voicing a common enough thought among engineers—are attacking a straw man. Times are not what they used to be—and they never were. The world is going to the demnition bow-wows. If youth but knew, if age but could. The first sign of the down-slope of the years, gentlemen critics, is discontent with the rising generation. Criticize it if you want to, but don't deceive yourselves as to the real basis of your criticism.

Convention Discussion

FEW meetings of road builders have furnished papers of so great practical value and so active a discussion of those papers as did the conference on asphalt roads which took place in Detroit last week under the auspices of the Asphalt Association. Every one of the half-score of papers was full of specific practical information which could be laid hold of by the road builder and put to use in his regular practice and several of the papers were positively unique in their presentation of details of methods and costs. And, let it be emphasized, these papers did not pass without discussion. Even those treating of the intricate technology of asphalt had their comment and criticism, while the discussion of the great number devoted to uses and construction had usually to be terminated by the chairman's necessity of getting on

with the program which provided four full three-hour sessions for the ten papers. This stress has been laid on discussion from the floor because of its rarity in most of the meetings of road builders. It has not been often in recent years at the meetings of national associations that any paper has received the consideration of an adequate discussion. Many and valuable papers have been dismissed with no more comment than the formal thanks of the chairman to the author. This situation is wholly bad. It discourages the writing of papers and it discourages the program committees in their efforts to find good subjects and good writers. It is scant reward for a man who spreads out in text and illustration his expert knowledge of some road building procedure or practice to have it received with the silence of a Quaker meeting. In the next ninety days there will occur half a dozen major conventions of road engineers and contractors. A half a hundred perhaps of good road builders will read papers at these six meetings. Their audiences can pay them the best possible compliment by discussing the facts and theories which they offer for consideration.

A City Engineer Who Knows His Job

IN ONE of the small cities visited in the preparation of the current series of articles on the engineering conduct of this class of municipalities the mayor told a story. The mayor was himself a doctor, who for four years had been on the council and was in his first mayoralty term. The city is putting through a major street improvement within the business center of the town, an improvement which involves much removal of existing obstructions and expensive private reconstruction work by many owners. In the ordinary process the matter of the negotiation with these owners came up in council, and in accordance with custom the motion was made that the city attorney be instructed to discuss with the owners the respective rights, obligations and damages of the public and private interests. Right here the mayor intervened, "No," he said, "This street improvement is an engineering matter; the city engineer is the man who knows what the city is doing and he's the man who knows what we want the citizens to do. Let him do the negotiating." And it was so ordered. Inside of two weeks, said the mayor, the city engineer appeared before the council with complete agreements from all owners to do what was to be done and the work has now gone through to successful completion, not only to the satisfaction of the city, with none of the litigation and expense usually following such negotiations, but with the publicly expressed appreciation of the property owners for the celerity with which the work has been done and the fairness with which the division of expense has been conducted. This is engineering in its highest sense—and the city engineer who was responsible is on his way to larger things.

To Regulate the Walker

RECENT reports from Los Angeles by those who have no interest in boosting that bustling city say that a remarkable change has come over the downtown section. Instead of being what it was a year ago, a maelstrom of uncontrolled traffic with pedestrians and motorists each pursuing his own sweet will under the complacent approval of the traffic cop, it has become an orderly procession of cars and walkers, each going when the signals so invite and stopping promptly and continuously when the signals shift. This happy result, it is claimed, is due to the strict enforcement of the stop-go orders on the pedestrian at crossings, an enforcement at first backed up by police court punishment but by practice soon reduced to the mere shift of signal or upturned hand of authority. The experience is worth noting for other cities. The nervous American, when afoot, no longer waits for paralleling traffic before crossing streets but stands, like the runner in the old game of "prisoner's base," ready to dart out and thread the opposing traffic at any time that there is even a fair chance to make the other side of the street without death or injury. The habit is growing as delays become more prolonged and is encouraged by the automatic control which turns signals on a time basis regardless of density of traffic. The pedestrian is absolutely unregulated and this lack of regulation contributes much to the traffic mess at busy corners. The adoption of punitive measures such as Los Angeles has been successful with is worth trying in all communities where this "darting" habit is common, but with it must come a control of the intervals of signal shifting which bear a relation to the relative and changing densities of traffic.

One Hundred Years

ON Nov. 4, 1825, amid the booming of cannon and the pealing of bells, waters from the Great Lakes were ceremoniously poured into the waters of the Hudson from the first boat that came through the completed Erie Canal. The ceremony marked the beginning of an era, the era of rapid and easy inland transportation. Man's mind was moving fast in those days, so the canal era was brief, but it was long enough to show the world what cheap transport meant and to encourage inventiveness in new means of easy transport. Hard after the canal came the railroad, and its startling growth was in no small measure due to the engineering personnel that the canal had developed. One hundred years ago this week real engineering in America had its first conspicuous acknowledgment; the date is worthy of remembrance.

A Giant in His Day

ON THE tablet celebrating the opening of the Chesapeake & Delaware Canal, illustrated on p. 702 of this issue, will be found the name of Benjamin Wright, chief engineer. Now that this century-old waterway is being enlarged to meet modern demands it is fitting that recognition should be made once more of the services of this pioneer in our profession. A lawyer by education, Benjamin Wright at 21, in 1791, turned surveyor and worked on the first survey made for a canal in New York State—a short stretch near Rome. From then on he was committed to the canal as a life work. For twenty years, years lost largely to history, he worked along the Mohawk Valley, to emerge in 1816 as the engineer in charge of construcing the middle section of the Erie Canal and the year following he became chief engineer of that epoch making project. This was now the hey-day of the canal and Judge Wright its most famous exponent. There was

not one of the famous waterways of the era which did not seek his counsel and of most he was the leading spirit. Farmington, Blackstone, Chesapeake & Delaware, Chesapeake & Ohio, Delaware & Hudson, St. Lawrence and Welland and that provocative passageway from Chicago to the Illinois River—to list his canals is to list those which have to this day persisted against the attacks of time and of economics. In the twilight of his life the railroad came, and with the foresight of the true engineer he adapted himself to its novelties, but his time was spent and he had left only a year or two—but they were enough to project a road in Cuba and to become chief engineer of the Tioga & Chemung R.R. He died in 1842. The "Father of American Engineering" he is sometimes called—a great and an ingenious man.

Suicidal Management

AS THOUGH the precarious condition of the Imperial Valley, under menace of drought, flood and alkali, were not sufficiently serious, the directors of the irrigation district to which the entire valley belongs have created a new menace worse than those already existing. They have cast aside their experienced technical advisers and propose to go it alone. R. S. Carberry, chief engineer; F. D. Pyle and H. M. Rouse, irrigation managers; and P. F. Jones and P. Rothi, irrigation superintendents, have been summarily dismissed. They had served the Imperial Valley up to 16 years, and had accumulated local experience of peculiar importance and value in the difficult tasks with which they were occupied. The district directors have discarded the bulk of their engineering staff, at a time when sound technical advice is more urgently needed than ever—when because of the threatening condition of the Colorado River the whole future of the valley and the lives and fortunes of thousands hang on technical knowldge and forethought. The action is a stupendous piece of suicidal management.

In dismissing the engineers, the directors explain that "high-priced engineers" are not essential and that the affairs of the district can be carried on without them. This attitude displays in part a not uncommon misunderstanding of the engineer's function after construction is over, and in part that self-confidence and thirst for authority which laymen in administrative positions are apt to develop. But the low cost of water and the involved management conditions of the Valley make both these reasons inadequate as explanations of the directors' surprising action. It may be suspected that other reasons, which the directors perhaps are not so anxious to publish, figure in the case.

Whether the directors, in spite of their pennywise pronunciamento, have other plans for obtaining the engineering advice which the operation of the district requires, is immaterial. Not only is regular resident engineering service the economical method in so extensive and distributed an enterprise, but in the case of Imperial it is also the only safe method. The service requires close supervision and that degree of sure judgment which derives from daily experience in the work. Thus, the long familiarity of the discharged engineers with the Colorado River and control of flow to the district canals represents a vital asset which the directors have wantonly discarded, and which they will not find it easy to replace.

That ill-advised, capricious management of this kind should affect any large enterprise at all is bad enough. It is worse in the case of the Imperial Valley, and this for reasons which have peculiar appeal to engineers. The district lies below the banks of the unruly Colorado, which is ever raising its alluvial bed and is erecting a toppling pyramid of danger which will soon fall over and destroy the valley if the ablest engineering skill is not constantly at work to hold it steady. Yet even in so critical a matter, the politician manager is free to dictate, in the full glory of his ignorance. Second, the money investments of the Imperial Valley are represented in securities of wide circulation, which have been bought and sold, and on which engineers may be called upon to give opinion. It will be their duty to take note of the multiplied danger of destruction created by the action of the directors of the district in discarding their chief safeguard, their experienced engineers.

Home Rule Instead of City-State

RECESSION by Chicago from Illinois because the down-state members of the Illinois Legislature have defeated the legislative reapportionment to which Chicago has been entitled since the 1920 census has been a summer season topic of the press of the country. Talk of secession is absurd. Separation into a city-state would be legally possible with the consent of the Legislature and Congress, but there is small chance that a legislature which refuses Chicago due representation would agree to separation. If Chicago were to become a city-state, why not every other rapidly growing metropolitan district, from Boston to San Francisco and Los Angeles? Already there has been talk of it at Detroit. Do we want a score of city states? There are strong arguments against city-states, each with its two senators and with the possibility of city blocs of considerable size in both Senate and House.

At the same time, the rural domination of the cities in some states, including Illinois, is most unfair. It is not merely rural domination; it is sometimes all the rest of the state against the metropolitan district, as witness the constitution of New York State, which provides that New York City shall never outbalance the rest of the state in legislative representation. There always has been and always will be an antagonism between city and country, based in part on the oldest and strongest instinct, self preservation.

One can sympathize with the Illinois legislators without condoning their denial of constitutional rights to Chicago when it is stated that Cook County, in which Chicago is located, already has 19 of the 51 legislative districts of the state and under the 1920 census is entitled to 24 of them, and by 1930 may perhaps rightfully demand a majority. This presents a troublesome problem but enlightened statesmanship can safeguard the interests of the whole and of the parts of a state alike without making any one part dominant. A means to this end is municipal home rule. This the cities of New York State have recently obtained but those of Illinois still lack. The immediate issue at Chicago, however, is no lack of constitutional rights, but the need of a united citizenship under capable leaders to enforce the rights already possessed.

A Sea Level Canal Between the Delaware and Chesapeake

Old Waterway Built in 1829 Enlarged by Sixteen Million Yards of Dredging to Carry Vessels of Twelve-foot Draft From Tidewater to Tidewater

PERHAPS the largest canal building task which the United States has undertaken since the work at Panama is approaching completion between the heads of Chesapeake and Delaware bays. It is a dredging operation of about 16,000,000 cu.yd., which changes an old boat-canal with locks to a sea-level canal with 12 ft. depth of water and a bottom width of 90 ft. Besides the excavation and lock removal there are required five major bridge crossings, jetties and dikes. All this work has had to be done in and over the old boat channel without stopping the canal traffic of considerable volume or the crossing road and railway travel. The procedure followed furnishes an interesting example of construction planning and performance.

Old Canal—The waterway known as the Chesapeake & Delaware Canal was opened for traffic July 4, 1829, four years after the first Erie Canal was finished and in the heyday of canal construction in America. As shown on the small headpiece map it was built at the geographically convenient situation where the head waters of these two major bays are only about 14 miles apart. Its strategic position for trade between the water of the Chesapeake and the Delaware is evidenced not only by its early commercial prosperity but by the fact that in 1924, operating still as a boat canal, it carried 683,206 tons of freight valued at $42,068,886.

As it exists the waterway comprises a short tidal entrance channel at its Delaware end; a 4.3 mile slack water section, with a level about 7½ ft. above mean low water, from Delaware City to St. Georges; a slack water section 9.3 miles long from St. Georges to Chesapeake City with a level 17½ ft. above mean low water, and a tidal section 4.2 miles long from Chesapeake City bayward in Back Creek and Elk River. In all, there are 13.6 miles of slack water and 4.3 miles of tidal canal navigation. The channel generally is navigable its full length of 17.9 miles for craft drawing 9 ft.

The canal was built by the Chesapeake & Delaware Canal Co., which still owned and operated the property when it was purchased by the United States in 1919. Its chief engineer was Benjamin Wright, sometimes called the "Father of American Engineering," who was also the chief engineer of the Erie Canal, and who was concerned in one way or another with practically every major canal enterprise of the 1820-35 period. In a commemorative tablet, Fig. 1, erected by the company, the following is told of the work:

> The construction of this canal was begun on the 15th of April, 1824, by Silas E. Weir, the chairman of the first committee of works whose zealous and efficient services to the company terminated with his life, on the 14th day of May, 1828.
>
> He was succeeded by Robert M. Lewis, under whose active supervision the work was continued and finished.
>
> In its progress through the Eastern level large sections of embankment sank 100 ft. below the adjoining surface, and the bottom of the excavation rose 40 ft. above its natural position. On the Deep Cut, more than 375,000 cu.yd. of earth slipped from the regulated slopes of the sides, and passed into the chamber of the canal.
>
> These and many other difficulties having been overcome, the water was introduced on the 4th of July, 1829; and the final accomplishment of this great National work was celebrated on the 17th of October

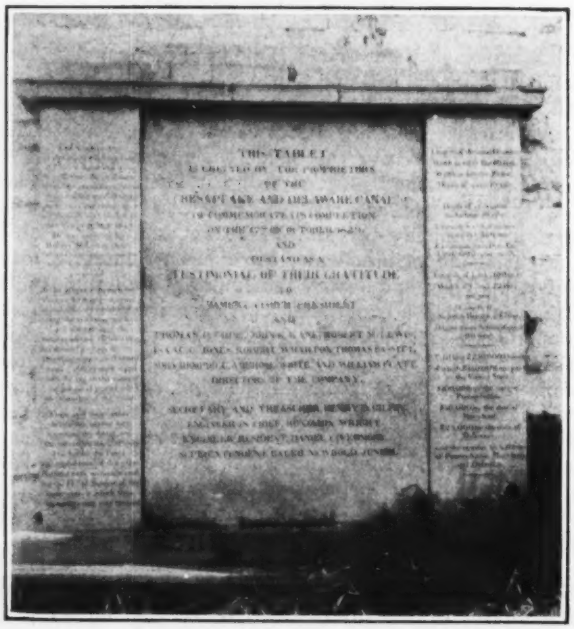


FIG. 1—TABLET ERECTED IN 1829 AT SUMMIT BRIDGE ON THE DELAWARE AND CHESAPEAKE CANAL

of the same year, at which time the navigation was opened.

Length of the canal, 13⅝ miles
Width at water line, 66 ft.
Width at bottom, 36 ft.
Depth of water, 10 ft.

Depth of excavation at Summit, 76½ ft.
Extreme width of section at surface, 366 ft.
Excavation from Deep Cut, 3,500,000 cu.yd.

Length of locks, 100 ft.
Width of locks, 22 ft.

Length of Summit Bridge, 247 ft.
Height above bottom of canal, 90 ft.

Total cost 2,250,000 dollars of which $450,000 was paid by the United States, $100,000 by the State of Pennsylvania, $50,000 by the State of Maryland, $25,000 by the State of Delaware, and the residue by citizens of Pennsylvania, Maryland and Delaware.

About 1850 the locks were enlarged to 220x24 ft., but otherwise the original waterway was virtually unchanged until the present improvement authorized by the River and Harbor Act of March 2, 1919.

Present Project—The improvement authorized by Congress provided for the purchase of the old canal

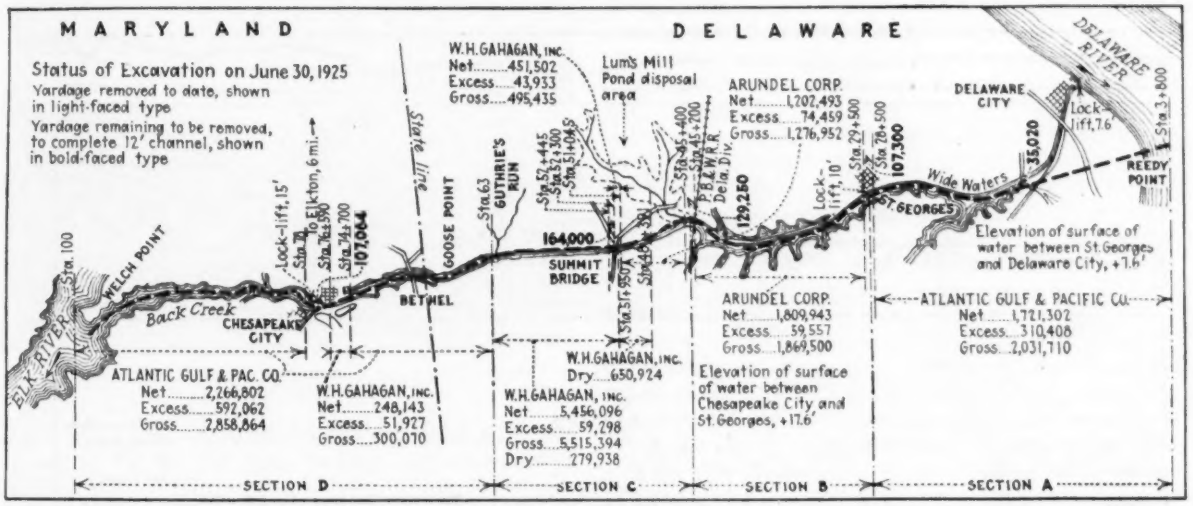


FIG. 2—LOCATION AND QUANTITY MAP OF DELAWARE AND CHESAPEAKE CANAL

property for $2,514,290, and its enlargement, following the old route except for about a mile at the eastern end (Fig. 2), to a sea-level canal 12 ft. deep at mean low water and 90 ft. wide, with an approach at the Delaware end 150 ft. wide and another of the same width in Back Creek. Besides the new channel at the Delaware end, the old canal will be made a branch channel 12 ft. deep and 36 ft. wide. The jetties are rubble mounds on fascine mattresses, are 650 ft. apart at the shore ends and 800 ft. apart at the sea ends, and are 1,460 ft. and 1,320 ft. long. The plan and locality map, Fig. 2, indicates the new and old routes and structures.

Several features of the project deserve attention. The first factor in a sea-level canal was the tide ranges. At the Delaware end the mean range is 6 ft. and at Chesapeake City it is 2½ ft. There is, however, a difference of about two hours in the phases of the tides at opposite ends. Careful records kept of heights and phases submitted to calculation indicate a maximum tidal current in the canal of 1.3 miles an hour practically of no hindrance to navigation. This maximum velocity was calculated by using Eytelwein's formula with maximum head as 2.8 ft. and depth below mean tide as 15 ft. As planned the canal is 12 ft. deep. This is regarded as the first step in enlargement. Future possibilities contemplate two further enlargements as indicated on the cross-section, Fig. 3.

This cross-section is taken at one of the road bridge crossings, to indicate also other structural features. All bridges across the canal are vertical lift bridges of 175-ft. clear span and a clear lift above low water level of 140 ft. The span and the depth of foundation, it will be noted, are planned for the final enlargement of the canal prism. It will be noted, too, that the pier locations all come on land. This is virtually true of all bridge crossings, of which there are five including the double-track Pennsylvania R.R. bridge. Comparative designs indicated that vertical lifts were least expensive; this was also demonstrated by comparative bids.

In location the improved channel will follow very closely the line of the old canal except, as noted, at the Delaware end. Here the straight cut through to Reedy Point gives entrance directly into the main ship channel of the Delaware River. To have swung north to Delaware City on the old route would have required a back swing channel. However, the old route to Delaware City will be deepened and will serve as a branch route if contemplated plans are carried out.

Construction Plan—The controlling construction condition was the requirement that navigation in the old

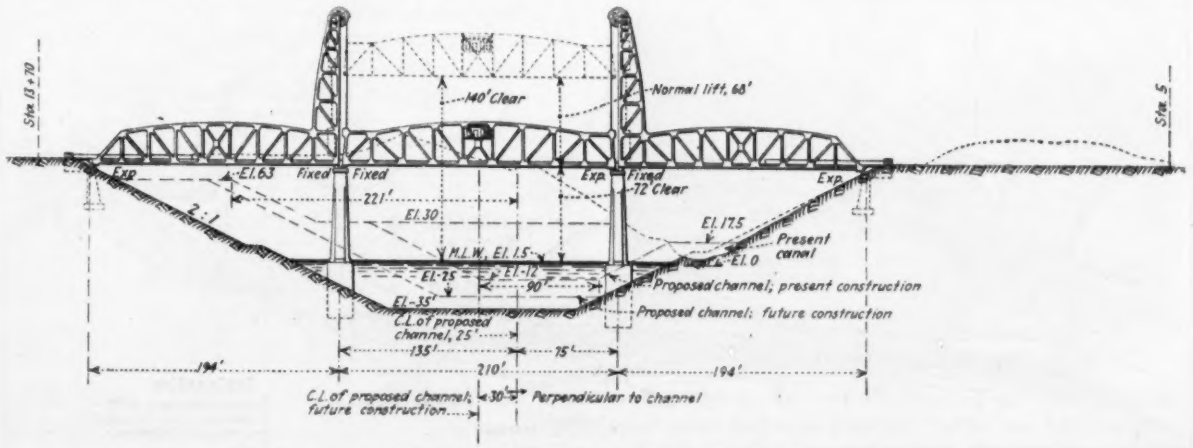


FIG. 3—CANAL CROSS-SECTIONS AND TYPE OF BRIDGE CROSSING

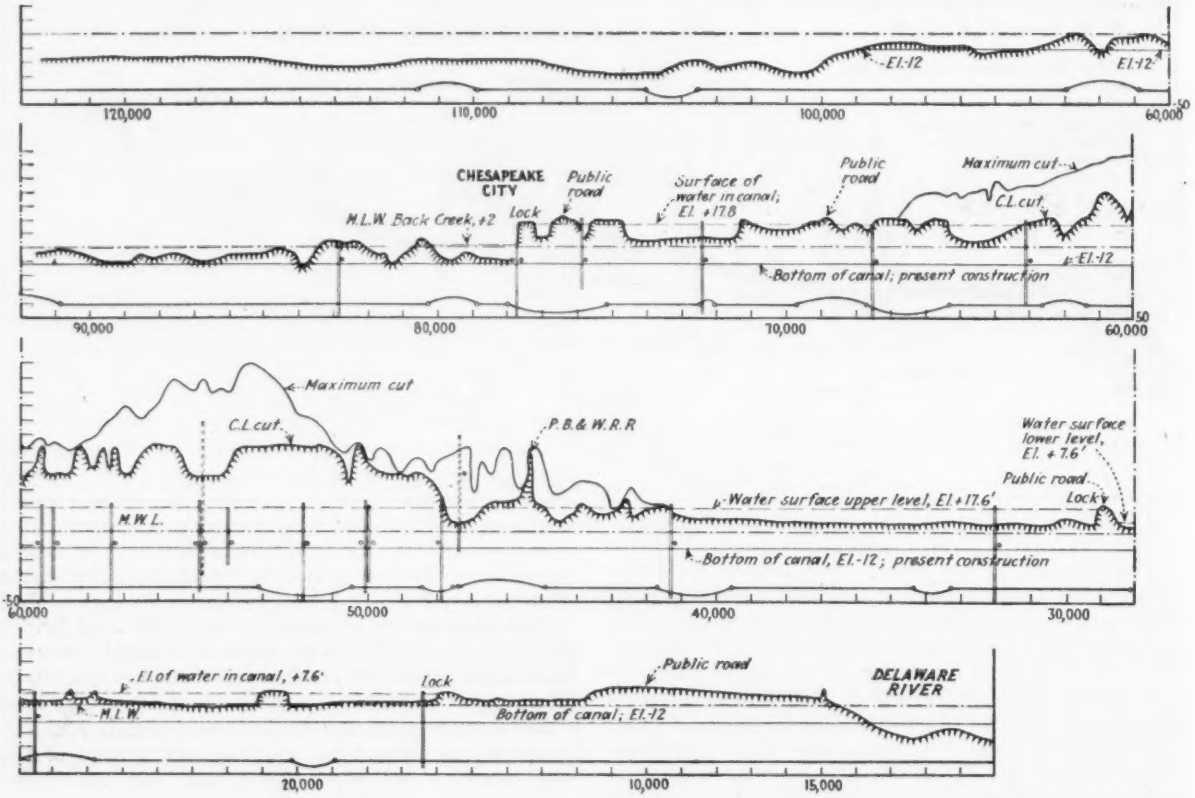


FIG. 4—EXCAVATION PROFILE OF SEA-LEVEL CHANNEL OF CHESAPEAKE & DELAWARE CANAL ENLARGEMENT

canal should continue as nearly as possible unimpeded during the work of improvement. As indicated, the canal had two levels above the tidal channel. Two plans were practicable. One was to deepen the old channel to El. —12 by a narrow cut, take out the locks and then widen the narrow cut to full-prism dimensions; the other was to complete the canal to full section except at the locks and remove the locks as the last operation. The second plan was adopted, chiefly for these reasons:

1. With the old levels maintained there would always be ample channel room for both navigation and the operations of widening channel. This was an important advantage both to traffic and to construction operations.

2. With a narrow cut made and the water drawn down, the hazard from slides was increased. With a new cut slides were certain and with a narrow cut any considerable slide was likely to block the waterway. Making the full cut at the original water levels decreased this hazard because the water head remained to hold back the earth and because no ordinary slide would be sufficient to block navigation in the wide waterway.

3. Keeping the old levels enabled all the widening to be done by dredging which is only a little more than half as expensive as dry excavation. A part of the work actually done in the dry as described later cost

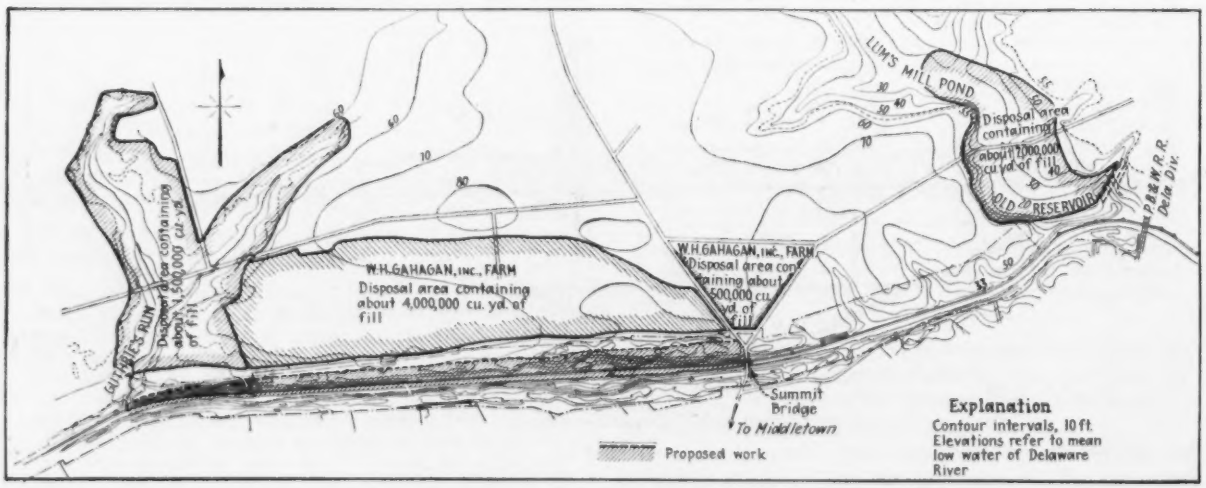

LUMS MILL POND
Disposal area containing about 2,000,000 cu. yd. of fill
OLD RESERVOIR
P.B. & W.R.R. Dela. Div.
W.H. GAHAGAN, INC., FARM
Disposal area containing about 4,000,000 cu. yd. of fill
W.H. GAHAGAN, INC., FARM
Disposal area containing about 500,000 cu. yd. of fill
GUTTERIES RUN
Disposal area containing about 1,500,000 cu. yds. of fill
Summit Bridge
To Middletown
Proposed work
Explanation
Contour intervals, 10 ft.
Elevations refer to mean low water of Delaware River

FIG. 5—SUMMIT CUT AND SPOIL AREAS

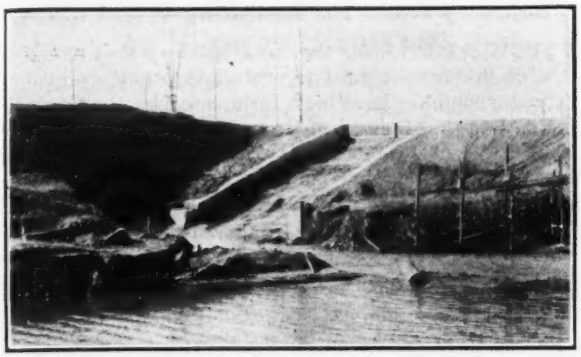


FIG. 6—PERMANENT SPILLWAY FOR GUTHRIES RUN BASIN

37c. a cubic yard while the dredge work cost only from 12.44c. to 43c. a cubic yard (average for all contracts 22.76c.).

The high water level and dredging plan being decided on, disposal conditions dictated that the widening should all be done on the north side. This was then the plan: To make a hydraulic dredge cut deepening the old channel and widening it toward the north bank. This plan refers of course only to the slack water sections; in the tidal sections the operation was dredging channel in open waterways and placing the spoil where convenient. The excavation profile is shown by Fig. 4 and Fig. 2 gives the quantities and the contract divisions.

For construction the canal was divided into four sections of which *A* and *D* were the tidal sections. That portion between the Delaware River and St. Georges lock passed through territory in general low and flat, with swamps for a large part of the distance, and with moderately high banks for the remainder. The same character of land with a somewhat larger percentage of high banks prevailed from the St. Georges lock to the railroad bridge of the Delaware Division of the Pennsylvania R.R. From this point to Guthries Run, a distance of about 4 miles, the canal passed through the divide between the Delaware River and Chesapeake Bay, the height of the banks averaging 50 to 80 ft. above the water of the summit level. The material was loam, sand, mud and clay and in the deep cuts was subject to slides. Virtually all was earth well suited to hydraulic dredging.

Dredging and Disposal—Except for the small quantities, less than a million yards, listed as dry on Fig. 2, all of the excavation has been done by dredges. As the old canal was kept in operation and the locks would not pass dredges and their tenders and scows the first problem was to get the plant into the canal. At Chesapeake City an old saving basin near the lock was diverted to locking purposes. Steel sheeting put in and taken out as required served as the lock gates. Virtually all dredging equipment was put into the canal and taken out again by this means except one dredge at the east end. Here the dredge working through from Reedy Point as it came to the old canal built a dam behind itself and then cut through into the higher level. By reversing the operation this same dredge locked itself back into the sea-level channel.

All the work divided as shown by Fig. 2 was done by three dredging contractors. On the sea-level stretches at the ends the work was deepening natural channel on a course laid out to take all the advantage possible of the deeper pools. The material was deposited alongside the canal in water or on shore behind dikes. Seven dredges were operated at various times as shown by the accompanying table.

All were hydraulic dredges, with revolving cutter

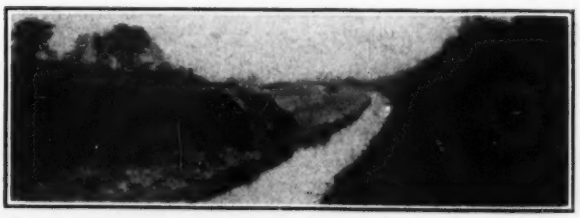


FIG. 7—VIEW SHOWING WIDENING CUT AND OLD CHESAPEAKE & DELAWARE CANAL

heads, pumping through steel pipe lines on pontoons and on shore. At both ends as shown by Fig. 2 a portion of the work was in the canal proper and the dredging plant used here had to be locked in as previously described.

In section *B* the conditions were much the same as in sections *A* and *D*. Disposal areas were found in the swampy bays of the ponds traversed and the operation was straightforward channel widening and deepening under water. The large task was between the P. W. & B. R.R. bridge and Guthries Run. As shown by the profile, Fig. 4, this was all deep cut operation, and disposal areas had to be provided behind the high banks.

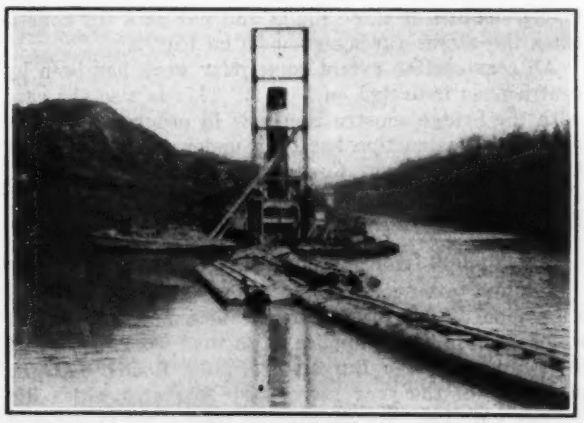


FIG. 8—DREDGE CUTTING DOWN HIGH BANK

A plan of the deep cut section showing the disposal areas is shown by Fig. 5. Low spots in the rims of

TABLE —DREDGE PERFORMANCE ON CHESAPEAKE & DELAWARE CANAL

Name	Period Worked	Size In.	Section	Yards
Washington	Sept. 24, 1923—Mar. 15, 1924	22	*A*	640,876
Clinton	July 7, 1924—Sept. 24, 1924	22	*A*	383,893
Cape May	Sept. 25, 1924—Feb. 26, 1925	20	*A*	696,533
Arundel	Oct. 1, 1923—July 20, 1924	22	*B*	1,728,169
Arundel	Nov. 13, 1924—Dec. 3, 1924	22	*B*	81,774
Arundel	July 21, 1924—Nov. 15, 1924	22	*C*	689,645
Claremont	Nov. 20, 1922—Nov. 30, 1924	26	*C*	4,162,039
Claremont	Mar. 6, 1925—May 12, 1925	26	*C*	451,502
Claremont	Jan. 7, 1925—Mar. 28, 1925	26	*D*	225,217
Claremont	May 13, 1925—May 17, 1925	26	*D*	22,926
W. H. Gahagan No. 5	Dec. 1, 1923—Dec. 30, 1925	26	*C*	1,522,994
Cape May	Sept. 24, 1923—Dec. 31, 1923	22	*D*	424,440
Clinton	Oct. 18, 1923—May 14, 1924	22	*D*	927,804
C. W. Catt	Dec. 12, 1923—June 12, 1924	27	*D*	914,558
Total				12,872,370
Dry excavation				716,479
Excess dredging				1,191,644
Remaining to be excavated				518,407
Grand total				15,298,900

these areas were closed by dikes and spillways were provided, principally into Guthries Run for the overflow. At Guthries Run also a permanent spillway, Fig. 6, had to be provided. All the widening, as shown by Fig. 4, was done on the north side of the canal. A good visualization of its extent is given by Fig. 7 which shows a portion of the section excavated dry as denoted on Fig. 2. This steam shovel work was but a small portion of the yardage but the cut allows an excellent comparison of the old and the new canal. Ordinarily the dredges undercut and caved down the high bank above water as indicated by Fig. 8. A pipe line and disposal area are shown by Fig. 9. Here the end pipes with bottom ports are building up dikes. Indeed in methods and equipment all the way through there were only the regular practices, varied as the situation required.

Besides the routine requirements the specifications for dredging provided that: "To cover unavoidable inaccuracies of dredging processes, material actually removed to a depth of not more than 1 ft. below the required depth will be estimated and paid for at one-half contract price." Also it was provided that: "Material actually removed within limits approved by the contracting officer to provide final slopes not flatter than 1 on 2, but not in excess of the amount originally lying above this limiting side slope, will be estimated and paid for, whether dredged in original position or after having fallen into the cut." The material removed outside of these limits and not paid for constitutes the excess yardages shown on Fig. 2.

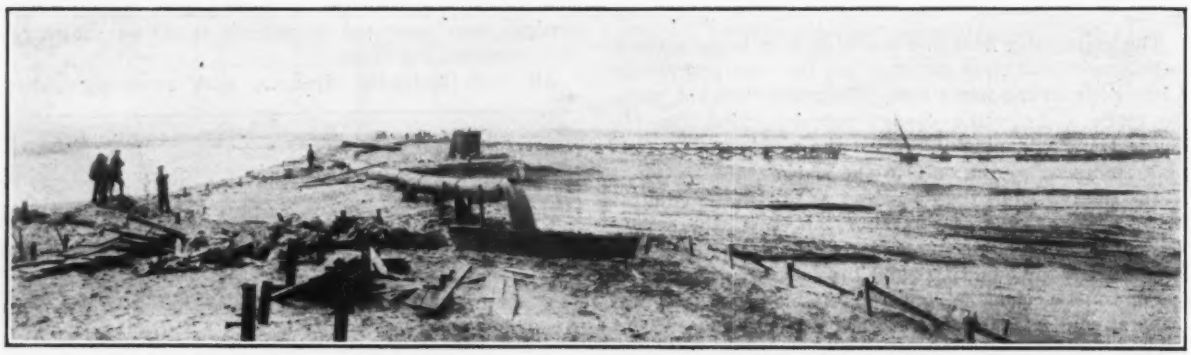


FIG. 9—TYPICAL SPOIL AREA AND PIPE LINE

All construction except some jetty work has been by contract, as indicated on Fig. 2. This is also the case with the bridge construction now in progress. All design and construction has been under the direction of Col. Earl I. Brown, Corps of Engineers, U. S. A., District Engineer, U. S. Engineer Office, Wilmington, Delaware.

$60,000,000 from Gasoline Taxes in Six Months

Gasoline taxes collected by the several states yielded a revenue of $60,108,734 in the first half of 1925 of which $53,814,240 is applicable to road work, according to a report by the Bureau of Public Roads. At the beginning of the year there were 13 states which did not tax gasoline. At the present time a tax is imposed in all states except Illinois, Massachusetts, New Jersey and New York. On July 1 the tax per gallon was 5c. in one state, 4c. in two states, 3½c. in one state, 3c. in twelve states, 2½c. in one state, 2c. in 23 states and 1c. in five states.

Sanitary Rules for Installing Well Pumps

REGULATIONS for the installation of well pumping machinery designed to protect the sanitary quality of water supplies have been formulated by the Committee on Sanitary Control of Ground Water Supplies of the Conference of State Sanitary Engineers and approved by a number of pump manufacturers. Some of these regulations are given below:

A. The use of a well pit or sub-ground-level pump room shall be avoided on account of the possibility of stoppage of the drain or ejector and neglect to replace the well top seal after making repairs.

B. Where the pump head is installed without a pit:

1. The pump head shall be installed on a concrete base of sufficient height to permit the outside casing to extend at least 4 in. above the pump room floor, and to enable the installation of a suitable connection as under *B*-2.

2. The annular opening between the outside casing and pump column shall be closed by means of a suitable water-tight connection which will effectually prevent waste water, oil or other contaminating material entering the well.

C. Where the pump head is installed with a pit or in a pump room below the ground level:

1. The sides and bottom of the pit or pump room below the ground level shall be constructed of watertight concrete. It is preferable that the pit be left uncovered, surrounded by a railing, to permit easy inspection by the operator.

2. The annular opening between the outside casing and pump column shall be closed by means of a watertight connection capable of withstanding for 24 hours, without leakage, the water pressure resulting from complete filling of the pit with water. The types of connections approved in order of preference are: (a) An all-flanged or threaded connection. (b) A stuffing box connection. (c) Metal to grouted cement connection with suitable gasket (not rubber), to be used only when joint carries weight of pump column and pump head is rigidly supported against vibration.

Any vents provided for the well shall be extended by a pipe with screw or flange connections to a point above the floor level. A return ell shall be screwed on the upper end of this pipe, and screened.

3. Drainage shall be provided for the pit. (a) By use of a drain consisting of a sewer pipe, not less than 6 in. in diameter, with cemented joints, installed in a straight line and on an even grade of not less than 0.6 ft. per 100 ft., with a concrete bulkhead at the outlet to insure an open discharge at all times; provided that under no conditions shall this drain receive sewage or be connected to a sewer and that the bottom of the pit so drained is above the high water level in any adjacent watercourse. (b) By means of a pump or ejector drawing from a sump of not less than 12 cu.ft. capacity situated so as to collect all waste water. This pump or ejector should operate automatically or be connected to some moving part of the pump head so as to operate continuously with this pump. This pump shall discharge above the pump room floor level.

4. The bottom of the pit or pump room shall be sloped away from the top of the well casing toward the drain or sump with at least 6-in. grade to insure ready flow.

Ships Unloaded by Barges Operating on Slipway Structure

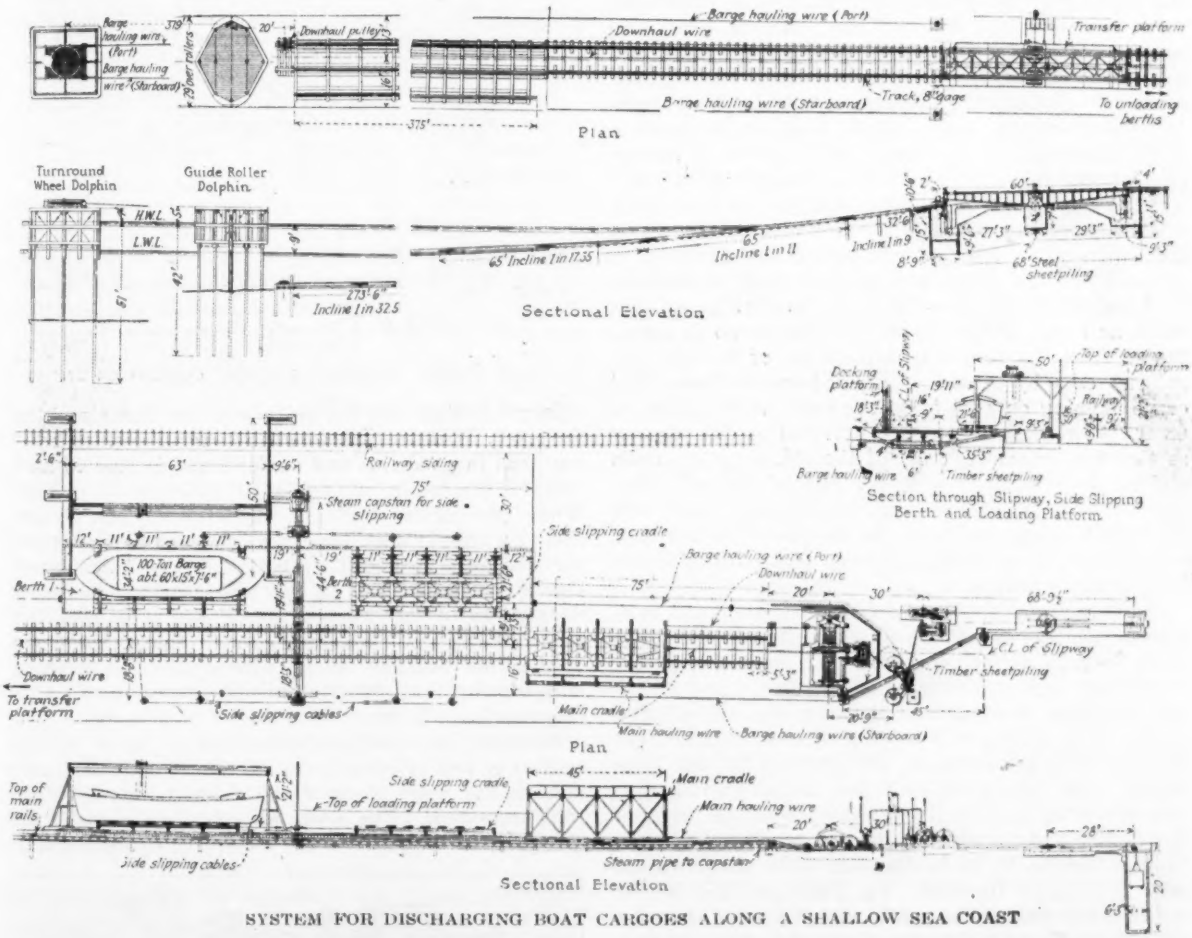
Method Used Where Construction of Piers Is Impractical Because of Distance of Deep Water From Shore

A STRUCTURE that has been erected on the west coast of Guatemala for landing ships' cargoes that have been transferred to barges is applicable to any coast line where the necessary depth of water for the flotation of ships at all stages of the tide is too far from the shore to insure economical construction of piers. The structure is a slipway built between a point ¼ mile from shore, the nearest approach that is possible by a deep sea vessel, and the unloading dock several hundred feet inland. The slipway provides trackage for a cradle that carries the barges from the water to the unloading point.

The constituent parts of the slipway system reading from the sea end, as shown in the drawing, are: Two dolphins which assist in placing the barges on the lower end of the slipway; the inclined portion of the slipway resting on the sea bottom and supported on piles; a girder platform mounted on central trunnion bearings and hydraulically controlled which effects the change necessary from inclined to horizontal track; the level portion of the slipway on shore; the unloading berths; the cradle for carrying the barges up the slipway; and the haulage systems—one for hauling the barges from the outside dolphin to the slipway, the main haulage system which operates the cradle on the slipway, and one for sideslipping the barges to the unloading berths.

Method of Operation—When a ship arrives, it anchors as near as possible to the outside or turnaround dolphin and transfers its cargo to barges. These are towed to the dolphin and attached to the inhaul rope by which they are pulled to the guide roller dolphin. From here they are transferred to the cradle on the slipway. The cradle is constructed entirely of steel, is 45 ft. long and consists of two parts, the main cradle that operates on the slipway tracks and a side-slipping cradle mounted on five transverse rails on top of the main cradle and used to side-slip the barges from the slipway into the unloading berths. An empty side-slipping cradle is shown in berth No. 2, while the main cradle has been stopped just beyond. On its starboard side, the main cradle has a docking platform which is clear of the water when the cradle is in its lowest position on the slipway.

The turnaround dolphin is a pile and timber structure used solely for mounting a pulley around which the barge hauling wires turn. This hauling system is used only to place the barges upon the cradle. The guide roller dolphin is also a pile and timber structure incorporating a platform of rollers that facilitates placing the barge in the correct location over the blocks on the cradle. The slipway as stated rests directly on the



SYSTEM FOR DISCHARGING BOAT CARGOES ALONG A SHALLOW SEA COAST

sea bottom. It consists of 70-lb. rails placed at 8-ft. gage and resting on timber ties. For the purpose of obtaining additional steadiness at the bottom of the slipway, a third rail is introduced and extends a distance of 375 ft. This extra rail accommodates a third set of rollers on the starboard side of the cradle. The total length of travel of the cradle is 806 ft. The incline of the slipway varies from one foot in 32.5 ft. at the bottom to one in 9 ft. near the top. The construction details of the horizontal portion of the slipway are essentially the same as the inclined portion.

Transfer Platform—The platform which transfers the barges from the incline to the horizontal is one of the features of the system. In swinging on its central transverse axis the rails of the platform come into proper registration with those of both the inclined and horizontal slipway. The platform is a steel girder structure controlled by hydraulic rams. The cradle in passing over the center of the platform depresses a lever releasing a trigger gear, and the platform swings slowly under the weight of the load at a speed controlled by the hydraulic system. When a barge has been taken up, the platform remains locked in a horizontal position until an empty barge returns, when the operation is reversed and the beam again takes an inclined position.

Unloading Procedure—Two unloading berths are provided as shown in the drawing. The cargo is transferred from the barges to a platform or directly into railway cars by means of a hand-operated overhead crane running on a 50-ft. girder track with a span of 63 ft. Registering stops are provided on the slipway so that the transverse rails of the side-slipping cradle will automatically line with the rails of the unloading berth. After discharging a side-slipping cradle and its loaded barge, the main cradle moves to the next berth, picks up an unloaded barge and returns to the bottom of the incline.

Haulage Systems—There are three separate and independent haulage systems, each operated by steam. The main haulage system operating the cradles is of the single wire rope type capable of handling a load of 165 tons including the weight of the main and side-slipping cradle on an incline of 1 to 9, at a speed of 20 ft. per minute. Change-over gears are provided for use when dealing with light loads over that incline or full loads over the lower part of the slipway where the gradient is 1 in 32.5 and the speed 80 ft. per minute. The main hauling wire is 3¼ in. in diameter while the downhaul cable is 1⅞ in. in diameter. The downhaul rope fastens to the lower side of the cradle and is passed around a pulley beneath the water at the lower end of the slipway. The main or uphaul cable is fastened to the top end of the cradle.

The haulage system for bringing the barges from the turnaround dolphin to the lower end of the slipway is of the endless rope type, the rope passing around a 10-ft. diameter pulley on the dolphin at the sea end, and on the land side fastened to a tension truck with a horizontal tension wheel of large diameter, the tension being maintained by a weight placed in a pit as shown in the drawing. The third haulage system is used to transfer the barges and side-slipping cradles in and out of the unloading berths.

The complete unloading system was designed by W. Gordon Glover, M. I. N. A., of London, S. W. 1, and was described in *Engineering*, London, Aug. 21, 1925, from which source this article has been prepared

Experiments with Concrete Ties

SATISFACTORY experience with a trial lot of twenty-two reinforced-concrete ties laid in May, 1916, at Eagle Pass, Texas, has led the Southern Pacific Ry. to make a hundred ties of the same type, which are to be placed in heavy-traffic main-line service. According to a statement by H. M. Lull, chief engineer, in the 1925 report of the tie committee, American Railway Engineering Association, relative to an inspection made in 1924: "The ties are apparently in as good condition as when they were installed. There is no indication whatever of impending failure."

This present installation, with nine years' service, is shown in Fig. 2, the track being opened up for a change in grade made necessary by raising the level of the

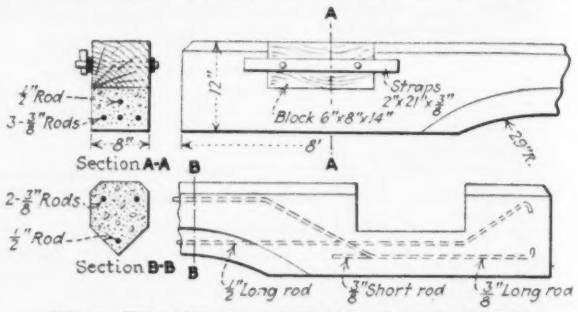


FIG. 1—THE "INDESTRUCTIBLE" CONCRETE TIE

adjacent bridge, just beyond where the man stands on the track. With ties spaced 18 to 26 in. c. to c. the track has kept in good line and surface, and is said to have required practically no tamping to maintain its surface. While the regular traffic is light, amounting to only about six trains daily, it is stated that there are frequent movements of switching engines, with the stopping and starting of heavy loads on this piece of track. Another installation of thirty-seven ties of the same type has been made on the standard-gage main line to the mines of the New Sabinas Co., at Cloete, Coahuila, Mexico. It is expected that concrete ties will be used in all future renewals on this line.

All these ties are of the form shown in Fig. 1. At the ends they are of rectangular section, 8 x 12 in., with recesses for wood blocks 8 x 6 x 14 in., to which the rails are spiked. The blocks absorb vibration and take the wear, so that there is no wear or disintegration of

FIG. 2—CONCRETE TIES AT EAGLE PASS, TEXAS

the concrete. They are held in place by iron straps and key-bolts, the bolts being slotted for vertical cotters or keys, as shown. At the middle, the tie is reduced to 10 in. in depth and is wedge-shaped on the bottom so that there is no tendency for the track to become center bound. A gravel concrete of 1:2:4 mix was used for the ties, with steel reinforcing rods arranged as shown in the drawing. These ties were invented and patented by F. C. Shearer, engineer for the U. S. Indestructible Tie Mfg. Co., Eagle Pass, Texas.

Steel Multiple Stops Swirling in Surge Chamber

Remedy Effected Without Decreasing Effectiveness of Surge Chamber or Interrupting Regular Service of Power Plant

WHEN an additional unit was recently added to the three already in service at the White River plant of the Puget Sound Light & Power Co., Seattle, Wash., it was found that the new combination of hydraulic conditions, not contemplated in the original design, caused a violent swirling in the surge chamber. The swirling and surging was eliminated and regulation was materially improved by putting a steel manifold in the bottom of the surge chamber. This was done without interfering with the service demands on the plant by adopting the construction scheme described below. Installation of this unit was described in *Engineering News-Record*, Sept. 10, 1925. p. 422.

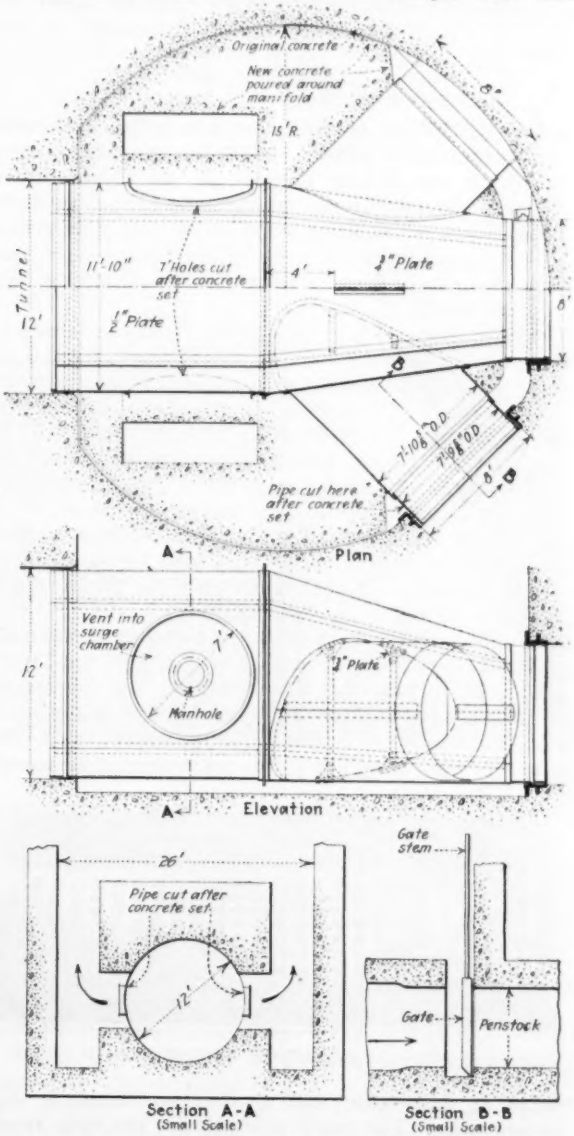
The surge chamber, 30 ft. in diameter, stands at the end of the supply tunnel, 12 ft. in diameter, and at the head of the penstock lines. The surge chamber was built with only three outlets and the new penstock supplying the recently installed fourth unit was tapped into one of these three lines a short distance below the surge chamber. For years the surge chamber has supplied three penstock lines without undue agitation and it was solely the increased flow incident to operating the new unit that caused the excess surging.

The first step in the installation of the multiple was to shut down the plant over a Sunday and take careful measurements in the surge chamber from which to build the steel special. On Memorial Day and the following Sunday, when the plant could conveniently be shut down for 48 hours, the multiple was completely installed, the three 8-ft. portions and the 12-ft. connection with the tunnel all being calked into their respective openings by means of lead gaskets driven home with steel packing rings.

When the manifold was in place the plant was put in service and pending completion of the work was operated without the surge chamber; that is, the penstocks were connected directly to the supply tunnel. Concrete was then placed around the steel multiple, burying it completely with the exception of a 7-ft. outlet on either side of the 12-ft. section where forms were built up to permit later access to the steel pipe. Small openings were also "formed out" where each 8-ft. pipe enters the tunnel outlet from the forebay.

When the concrete had set, the plant was shut down again at a convenient time and an oxyacetylene torch was used to cut away the steel of the manifold at the desired points. Cuts were made at the entrance to the 8-ft. outlets so that the gate valves could close as before and 7-ft. circular openings were cut on either side of the 12-ft. pipe through which water would have access to the surge chamber.

Incidentally in cutting out these 7-ft. openings from the 12-ft. pipe section, the manholes which were used to facilitate erection of the steel multiple were also



PLAN AND ELEVATION OF MANIFOLD IN BOTTOM OF SURGE CHAMBER

cut out, these manholes having been purposely located in the section that were to be later removed.

Thus after the concrete had been placed and the openings cut in the pipe line, the conditions were much as before so far as supplying the penstocks is concerned, but only a small part of the water passing through the steel multiple escapes into the forebay. The result of this, company officials report, is that the regulation has been very much better, that there has been no excessive surging (the water in the forebay rising and falling slowly) and all conditions improved.

The installation of the steel multiple was done under the direction of W. D. Shannon, construction engineer for the Puget Sound Power & Light Co., which is a subsidiary of Stone & Webster, Inc.

Large Multiple-Arch Dam Being Built in Italy

The Tidone Dam for Irrigation and Power 170 Ft. High—Cement Plant With Vertical Kilns Built Especially for the Concrete

By J. B. Lippincott
Consulting Engineer, Los Angeles, Calif.

An unusual multiple-arch dam with a maximum height of 53 meters (170.6 ft.) and 722 ft. long, known as the Tidone Barrage on the Tidone River, in northern Italy, is now under construction, about 38 miles southeast of Milan. The writer last year visited this structure in company with the chief engineer, Cav. Uff. Augusto Ballerio, from whom the following data were obtained.

The project is being built by an Italian syndicate of land owners primarily for the irrigation of 10,000 acres between the Apennines and the River Po near the town of Piacenza. This irrigation is of interest as the rainfall at Milan, which is in this region, averages 39.61 in. per annum. Of this rainfall 51 per cent occurs between April 1 and Sept. 30, but it is found that a safe water supply for agriculture in summer justifies the construction of irrigation works. While irrigation is of common practice in this region, this is said to be the first storage reservoir in the region built for the conservation of flood water for that purpose.

The complete plan includes the building of the main dam, herein described, for the regulation of the Tidone River, and a second structure 148 ft. high on one of its lower affluents, the Tidoncello, with reservoirs of 10,125 and 4,131 acre-feet capacity respectively. The drainage area tributary to the main dam is 32 square

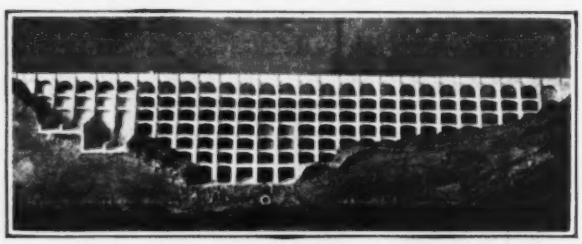


FIG. 1—VIEW OF MODEL OF TIDONE DAM IN ITALY

miles of mountains, and of the two combined 43.6 square miles. The runoff available for the main reservoir in normal years will fill it 4.5 times. The irrigation supply is estimated at 88 sec.-ft. The minimum supply for power is given as 44 sec.-ft. A small reservoir will be built at Nibbiano, below the power plants and above irrigation diversions, to regulate the fluctuations of flow due to the power demands so as to fit the irrigation requirements.

Contracts have been made for the sale of hydroelectric power to a Milan company so that the revenue from power sales will carry interest charges for the project and amortize the bonds is 30 years.

A report in Italian has been published under the following title: "Consorzio d'Irrigazione della Valtidone, Piacenza. Relazione Tecnico-Finanziaria 1920." P. F. Gemperle of this office has made the following review of this report:

Arch Design—The arches are inclined at an angle of 45 deg. with the horizontal and are circular in a plane normal to their line of inclination. They have a constant upstream radius of 16.4 ft. (5.0 m.) and subtend an angle of 180 deg. They vary in thickness from 1.15 ft. between El. 359 m. and El. 346.50 m. to 3.61 ft. at the stream bed, El. 314.50 m. They were designed by formulas of Professor Guidi, which are based on the elastic theory, for stresses due to hydrostatic pressure and for temperature stresses. In computing the latter it was assumed that the dam was

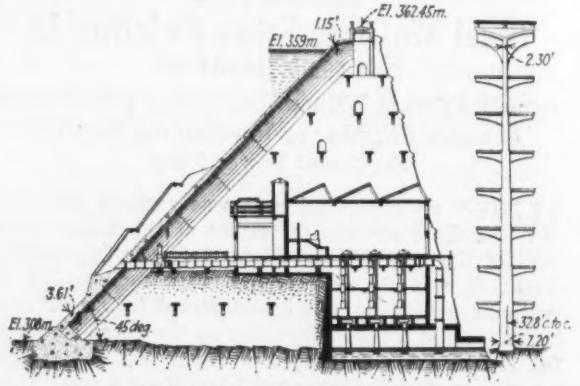


FIG. 2—SECTION THROUGH TIDONE DAM ON AXIS OF POWER PLANT

built at a temperature of 59 deg. F. (15 deg. C.) and that with a full reservoir the following temperatures occurred:

During winter	39 deg. F. (+ 4 deg. C.) at extrados	
	14 deg. F. (—10 deg. C.) at intrados	
During summer	50 deg. F. (+10 deg. C.) at extrados	
	86 deg. F. (+30 deg. C.) at intrados	

thus creating variations from the construction temperature of:

During winter	—20 deg. F. (—11 deg. C.) at extrados	
	—45 deg. F. (—25 deg. C.) at intrados	
During summer	— 9 deg. F. (— 5 deg. C.) at extrados	
	+27 deg. F. (+15 deg. C.) at intrados	

Under these assumptions the combined maximum compressive stress in the arches was found to be 613 lb. per sq.in. and the maximum tensile stress 18 lb. per sq.in.

In no case was the dead-load of the arches considered as it improves the distribution of the stresses.

Buttress Design—The buttresses are spaced 32.8 ft. center to center and their thickness varies from 2.30 ft. at the top to 7.22 ft. at the stream bed, the increase in thickness occurring in steps corresponding to the stepped thickness of the arches.

The buttresses were assumed to be independent of the arches and received as loads their dead weight, the weight of the arches and the water pressure. Under these conditions the maximum compressive stress was computed to be 261 lb. per sq.in. for a full reservoir and 106 lb. per sq.in. for an empty reservoir, with no tensile stresses at any point.

Cement Plant Built—The syndicate has built its own cement plant for the work. It is of interest because it is the old method of cement manufacture with certain improved details that have been developed by Cav. Ballerio. It has a battery of 3 gas kilns of 60,000 kilos of cement per 24-hr. day, or 330 barrels capacity. A shale-like rock containing 75 per cent carbonate of lime and 25 per cent silicate of alumina was found within a mile of the dam site. This is quarried and broken in sizes up to about 6 in. and put into vertical stone kilns 92 ft. high. The kiln is 10 ft. in circular

interior diameter on top and 10.5 ft. interior square at bottom. It has hollow walls. Coal costing $8.60 per ton is used to generate gas, which is introduced into two lower levels of the kilns where a temperature of 2,550 deg. F. is desired. It is said that the amount of coal required is 12 per cent of the weight of the stone. The stone is put in at the top of the kiln and taken out at the bottom at such rate as is required to produce the proper burning. The edges of the stone are fused but they are not vesicular as in the case of our standard manufacturing practice. The stone then goes directly to a revolving cylindrical mill 4½ ft. in diameter. Twenty per cent of raw silica is added at this stage. The mill is nearly horizontal. The first 6 ft. is a steel ball compartment. Next there is a 6-ft. screen compartment and then 17 ft. of a pebble mill. The material is ground until but 12 per cent remains on a 175 mesh screen. Gypsum is added to control the setting time.

Common labor is 2 lira per hour (8.6c.) for a 10-hr. day. Carpenters are paid from 13 to 17c. per hour. Electric power for operating the mill costs 1.6c. per kw.-hr. The cost data were not examined but with these unit costs including depreciation but excluding the cost of sacks, it is stated the cement is produced for 7.26 lira per 100 kg. at the mill or about 56c. per U. S. barrel.

Concrete—A testing laboratory with standard equipment is maintained at the works. The briquets for testing tensile strength are of much the same size and shape as those used in the United States. The cylinders for crushing are circular, 2.8 in. diameter, and the same height. Three breaks are made and averaged for each recorded test. Two months of these records were examined by the writer and the following extreme ranges of results were found, all samples being for mixtures of 1 cement to 3 of sand:

	Tensile Strength lb. per sq. in.		Compressive Strength lb. per sq. in.	
Time	Max.	Min.	Max.	Min.
7 days	469	327	4331	3266
28 days	540	379	5822	4150
3 months	...	...	5538	4936

The standard sand did not appear as good as our Ottawa sand. Only four of the compressive three-month tests were noted by the writer.

Stream-bed gravel is washed and screened for the concrete. The mixture is 1:2:4 in the foundations and abutments, and 1:1.8:3.6 in the arches. It is distributed through towers and spouts as shown in the accompanying view. It is stated that there are 31 lb. per cu.yd. of reinforcing steel in the buttresses and 72 lb. in the arches.

The bedrock formation is shale. The left abutment is poor and a large amount of stripping is necessary. Near the left abutment and under the dam the stream bed is covered with a slab of concrete apparently for the purpose of improving the foundations. Drain tile and vents are said to be used under this apron to prevent upward pressures. The writer does not have the data available to give further detail relative to this foundation slab. Large triangular masses of concrete are placed across the entire width of the canyon at the upper toe of the dam and as a cutoff wall as shown in the section. This is a new feature in this type of dam to the writer.

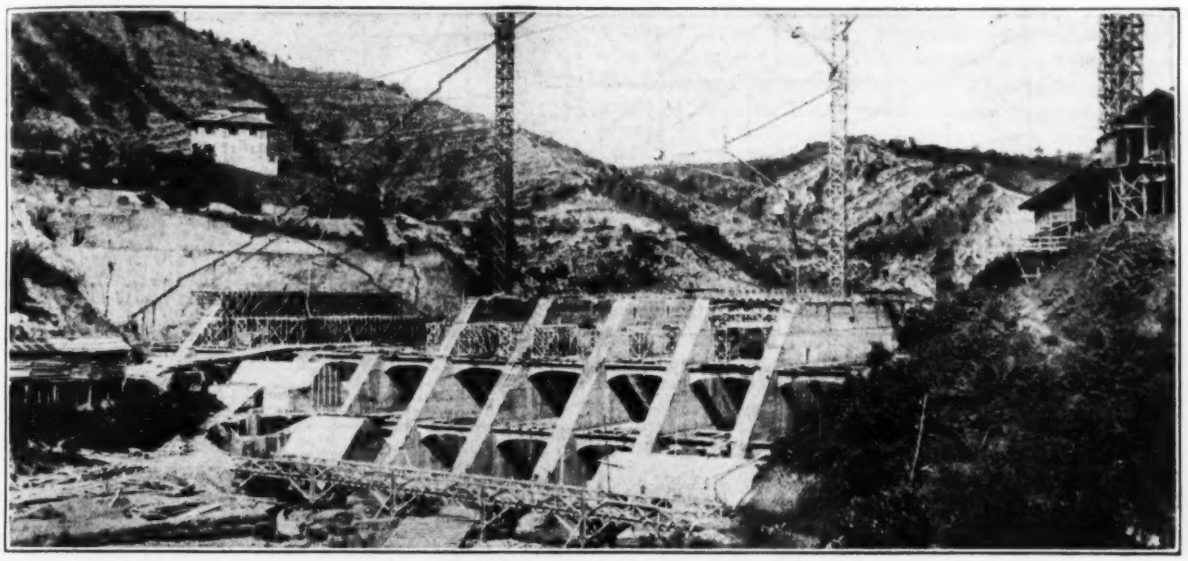


FIG. 3—TIDONE DAM UNDER CONSTRUCTION

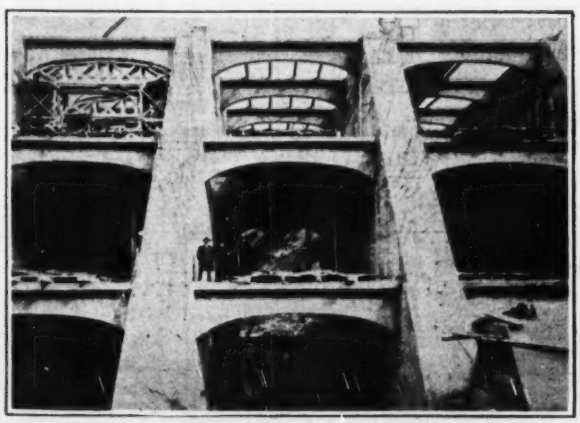


FIG. 4—LOOKING INTO THE BUTTRESSES OF ITALIAN MULTIPLE ARCH DAM

Thousand-Mile Road System Plan for Cook County

With 346 Miles Paved, Cook County Outside of Chicago Has Begun Program of 95 Miles a Year for Five Years

WITH 346 miles of paved road, Cook County outside of Chicago plans to double its hard-surface road system in the next few years. Coincidently it will be widening old pavement, putting in four-way intersections, eliminating crossings of railways at grade and doing various things, besides increasing mileage, to keep up with traffic needs. In several ways the new pavement practice and the improvement methods command attention. There is, however, a problem of wider interest in through route development and in securing ways of access to the great city embraced by the county. Now traffic enters by a few congested routes.

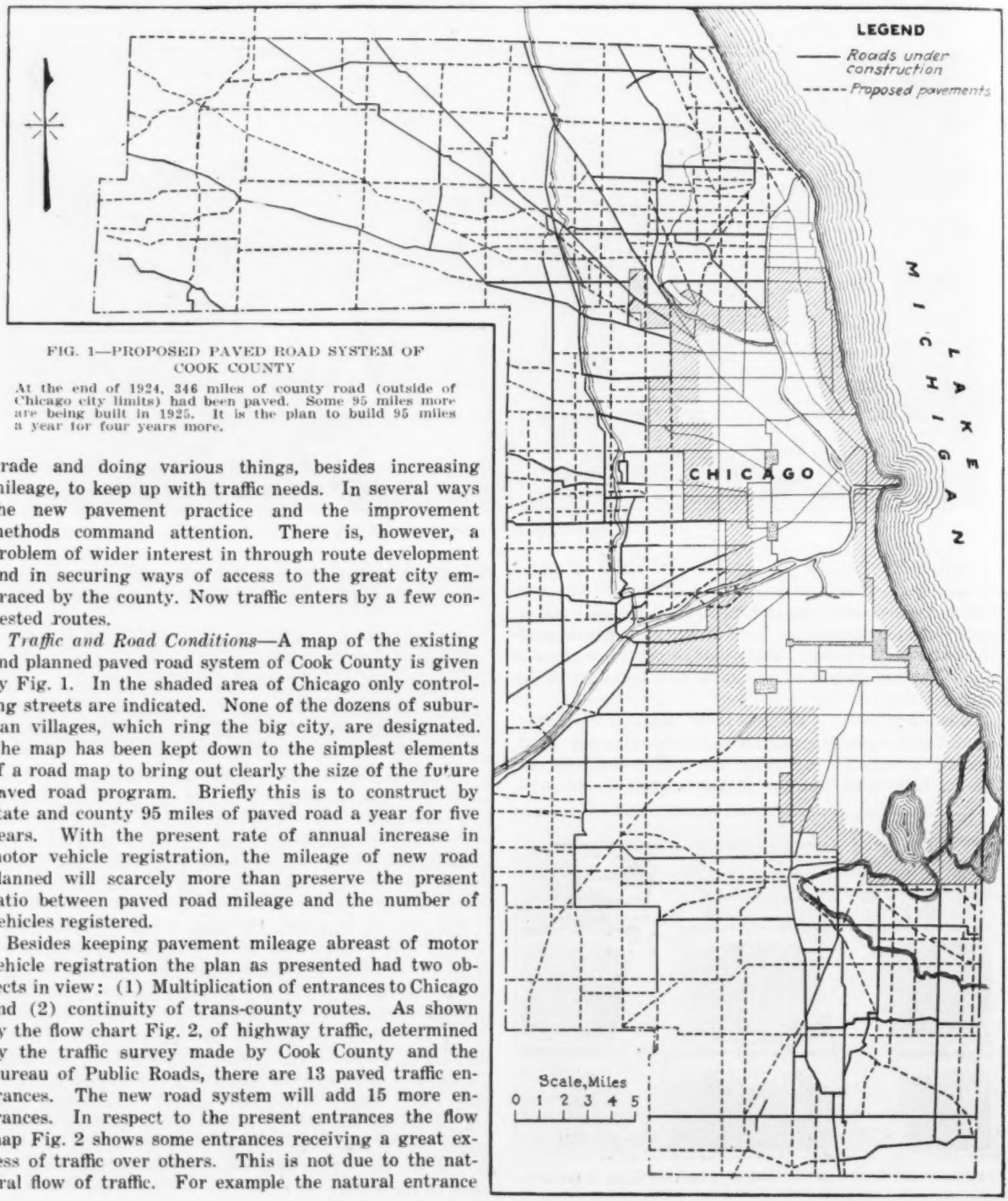


FIG. 1—PROPOSED PAVED ROAD SYSTEM OF COOK COUNTY

At the end of 1924, 346 miles of county road (outside of Chicago city limits) had been paved. Some 95 miles more are being built in 1925. It is the plan to build 95 miles a year for four years more.

Traffic and Road Conditions—A map of the existing and planned paved road system of Cook County is given by Fig. 1. In the shaded area of Chicago only controlling streets are indicated. None of the dozens of suburban villages, which ring the big city, are designated. The map has been kept down to the simplest elements of a road map to bring out clearly the size of the future paved road program. Briefly this is to construct by state and county 95 miles of paved road a year for five years. With the present rate of annual increase in motor vehicle registration, the mileage of new road planned will scarcely more than preserve the present ratio between paved road mileage and the number of vehicles registered.

Besides keeping pavement mileage abreast of motor vehicle registration the plan as presented had two objects in view: (1) Multiplication of entrances to Chicago and (2) continuity of trans-county routes. As shown by the flow chart Fig. 2, of highway traffic, determined by the traffic survey made by Cook County and the Bureau of Public Roads, there are 13 paved traffic entrances. The new road system will add 15 more entrances. In respect to the present entrances the flow map Fig. 2 shows some entrances receiving a great excess of traffic over others. This is not due to the natural flow of traffic. For example the natural entrance for traffic from the south is Halsted St. Instead 80 per cent of this traffic enters by Western Ave. This is due to the poor condition of Halsted St. in the city and to a group of grade crossings just south of the city line. Rather than delay at the crossings and travel over a

FIG. 2—FLOW OF COOK COUNTY-CHICAGO TRAFFIC

boards shall have power to acquire right-of-way for the laying out, altering or widening any public highway situated within the county, and if compensation therefor cannot be agreed upon with the owner thereof, to condemn in the name of the county in some manner as near as may be provided in "An Act to Provide for the Exercise of the Right of Eminent Domain," but the county shall not be required in any case to furnish bond. While the old law had been a serious problem in the opening up of new roads in the county, with the passage of this act this obstacle has been removed. The physical obstacles are greatest however.

1. Running southwest from the city are three parallel streams, the Des Plaines River, the Main Drainage Channel of the Sanitary District and the old Illinois and Michigan Canal. The location of a road across these streams is so expensive that at present in a distance of 20 miles there are only three crossings. This factor limits the location of highways to a lesser extent all the way up the Des Plaines River as far as Wheeling.

2. Chicago has become the greatest railroad terminal in the world and its railroads have been forced in many instances to place their large yards and shops outside the city limits. These yards are practically insurmountable barriers to highway location, as grade crossings are out of the question and the cost of either viaducts over or subways under multiple track layouts is prohibitive.

3. Another barrier that is rapidly becoming a very

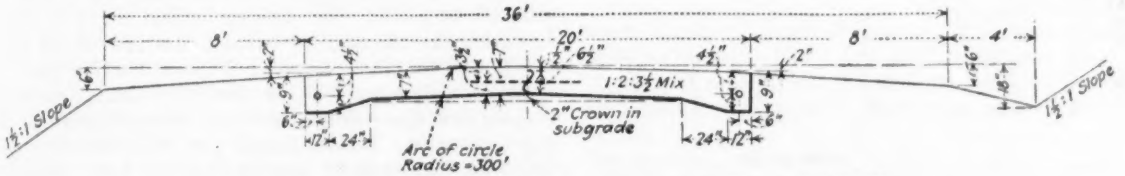


FIG. 4—STANDARD ROAD SECTION WITH CONCRETE PAVEMENT

rough street, traffic detours 4 miles to get onto Western Ave. This condition is duplicated at several entrances. The fifteen new entrances of the county system will improve conditions but more particularly the county and the city are working together so that where the county road delivers its traffic it will find an improved city street to receive it.

Besides giving more and wider entrances to Chicago the new county system multiplies trans-county roads. With all the roads of Cook County, a survey shows only a few continuous routes north and south or east and west. A map of a section of the county showing only north and south roads but all of them, is given by Fig. 3. The lack of continuity of route is outstanding. A plan of the east and west roads is no better. And this section of the county is no worse than others. By closing gaps the new county system will provide through-county routes.

So much for the broad county plan (1) To increase mileage, (2) To multiply entrances into Chicago and (3) To provide through-county routes. It has some serious obstacles to overcome. Until this year one was legislative. By the previous state law it took about two years to get possession of new right-of-way after the consent of the property owners. At the last session of the legislature a senate bill amending the "Law in Relation to Roads and Bridges," was approved May 25, 1925. The amendment provides that the several county

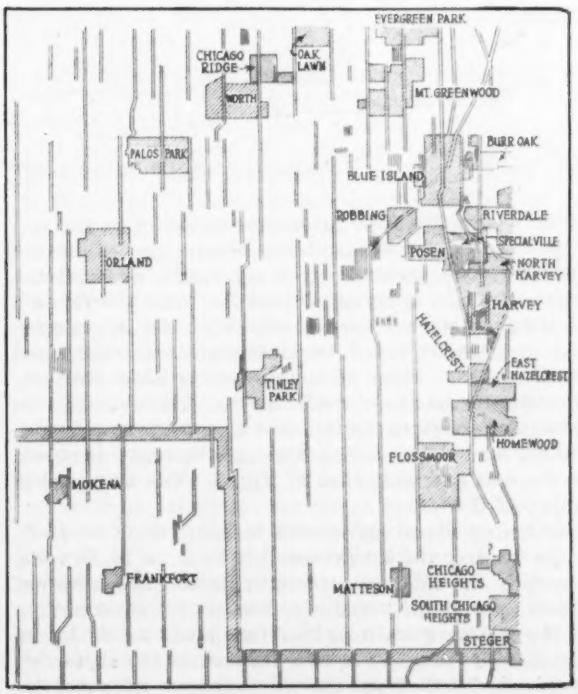


FIG. 3—PRESENT NON-CONTINUITY OF COUNTY ROADS

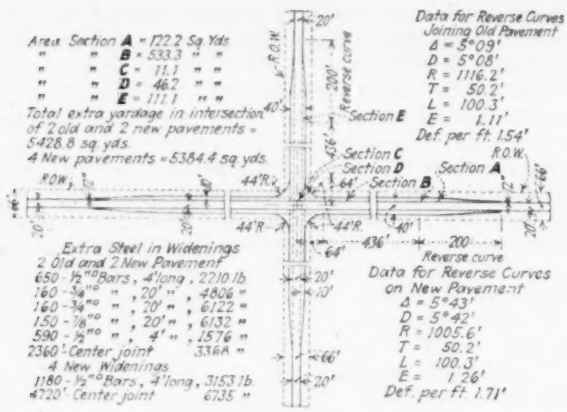

Area Section A = 122.2 Sq. Yds
" " B = 533.3 " "
" " C = 11.1 " "
" " D = 46.2 " "
" " E = 111.1 " "
Total extra yardage in intersection of 2 old and 2 new pavements = 5428.8 sq. yds.
4 New pavements = 5384.4 sq. yds.
Data for Reverse Curves Joining Old Pavement
Δ = 5°09'
D = 5°08'
R = 1116.2'
T = 50.2'
L = 100.3'
E = 1.11'
Def. per ft. 1.54'
Section E
Section C
Section D
Section A
Section B
R.O.W.
Reverse curve
Extra Steel in Widenings
2 Old and 2 New Pavement
650 - ½"ø Bars, 4' long, 2210 lb
160 - ¾"ø " , 20' " , 4806 "
160 - ¾"ø " , 20' " , 6122 "
150 - ⅞"ø " , 20' " , 6132 "
590 - ½"ø " , 4' " , 1576 "
2360' Center joint 3368 "
4 New Widenings
1180 - ½"ø Bars, 4' long, 3153 lb
4720' Center joint 6735 "
Data for Reverse Curves on New Pavement
Δ = 5°43'
D = 5°42'
R = 1005.6'
T = 50.2'
L = 100.3'
E = 1.26'
Def. per ft. 1.71'

FIG. 5—FOUR TRACK INTERSECTION FOR TWO-TRACK ROADS

important one is the "special use area." A tract of ground once set aside for a cemetery or a golf club and which has been improved for such use influences in a large measure the location of highways. Although such areas demand reasonable access to a paved highway, any attempt to obtain from them any right-of-way for highway purposes usually meets with strong opposition.

The new road plan as indicated by Fig. 1 is worked out to overcome these obstacles so far as conditions can be anticipated.

Design and Construction—Generally concrete roads are being constructed, the design and construction being substantially those employed by the Illinois Division of Highways. The new roads, however, are being built

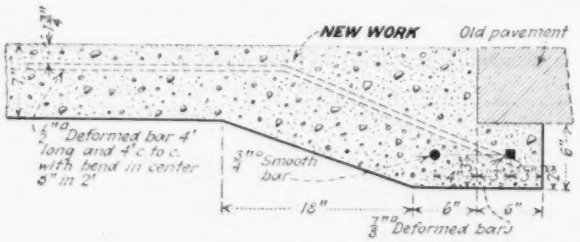


FIG. 6—JOINT OF OLD PAVEMENT AND WIDENING STRIP

36 ft. wide with 20-ft. pavements as shown by the section Fig. 4. At intersections, where new roads are built crossing each other or old roads, a four-track width of 40 ft. is being adopted for some 500 ft. each of the four ways from the crossing. An intersection plan is shown by Fig. 5, which also gives quantities and location data. These widenings are proving decidedly effective in speeding traffic across intersections. In construction, where the intersection is with an old road, the old road slab is widened out at the edges as shown by the east and west road of Fig. 5. The new road is built to full width.

Widening of old pavements is being done in 10-ft. strips whether the old pavement is 18 ft. or 20 ft. wide. Generally the older pavements being widened were not of the present thickened-edge section. The connection of the widening strip is therefore made as shown by Fig. 6. The drawing is of a fraction of the slab only; it extends 10 ft. from the old pavement edge and its outer edge is of the same thickened section shown by Fig. 4. In Fig. 6 notice is called to the wide underpinning, 6 in., of the old slab and to the cantilever reinforcement. A very stiff junction has been adopted to get away from the common hazard of the widening slab breaking away, or settling differently, from the old pavement.

The Cook County Department of Highways, Geo. A. Quinlan, superintendent, is directing all of the work of the new county road system.

The Tri-Cities' Activated-Sludge Plant at Alhambra, Calif.

Many Changes Necessitated by Inadequate Initial Capacity—Continuous Filters Dewater Sludge—Additions Planned

THE TRI-CITIES' activated-sludge plant, built to serve Pasadena (including San Marino), South Pasadena and Alhambra, in southern California, and located in Alhambra, was put into service in January, 1924. Including additions since completed or now under way, the plant embraces 2 Dorr fine screens, 18 aëration tanks, 4 settling tanks (Dorr clarifiers), 11 sludge re-aëration tanks and 2 Oliver sludge filters. The effluent is used on the Pasadena sewage farm, or as much of it as can be used there. The plant was designed to dispose of sewage from an ultimate population of 100,000, which it was expected would be reached in 1930. In making plans for the plant, however, the quantity of sewage, the growth of population and the time required for construction were all underestimated and by the time the plant was ready for service the sewage flow was nearly equal to the plant capacity. It was found, also, that the operation could be improved by lengthening the 4-hr. detention period which was the basis on which the design had been worked out.

The Plant in Operation—Since the plant went into service, equipment designed for an average of 5 m.g.d., with a maximum of 8 m.g.d., has actually taken average flows up to 6 m.g.d., with maximums of over 12 m.g.d. In fact the actual volume handled has been about 25 per cent greater than this on account of the volume of return sludge used. Operation on this scale has been made possible by several changes in the original design made from time to time in an endeavor to keep ahead of the increasing quantity of sewage received. Making these changes during operation has interfered, to some degree at least, with operating the plant in the most efficient manner, but in recent months much more satisfactory operation has been secured. At no time, operators of the plant state, has there been any difficulty in obtaining an effluent of purity superior to the requirements of the State Board of Health.

Due to the necessity of replacing an unsatisfactory sludge dewatering process, large quantities of sludge accumulated at the plant. This sludge has had to be lagooned from time to time in the Arroyo San Pasqual, a "wash" crossing the city farm which adjoins the plant. Odors from this wash and from sludge spread upon the farm as fertilizer have been erroneously ascribed to the plant itself, which is reported to be normally free from odors that could cause nuisance to surrounding property. This lagooning, which was wholly an emergency measure, has been reduced as

improvements in sludge filtering have been made and when this article was being written it was expected that the lagooning practice would soon be discontinued altogether.

The problem of sludge disposal has been given much thought. Since the first of the year two Oliver continuous filters have been put into operation for dewatering the sludge. They reduce sludge with a moisture content of 99.2 per cent to a sludge cake of about 80 per cent moisture. The monthly capacity of these filters is about 1,000 tons of sludge (80 to 82 per cent moisture). At this moisture content the sludge cake is of about the consistency of wet blotting paper and is readily distributed over the farm by an ordinary manure spreader. When dried to about 10 per cent moisture the sludge shows 7.79 per cent of total nitrogen calculated as ammonia, of which 3.18 per cent is water soluble, and a total phosphoric acid content of 3.94 per cent. At this consistency and with these chemical proportions the sludge is said to be worth from 50 to 75c. per ton as fertilizer.

The plant as originally laid out includes a Dorr fine screen, 18 aërating tanks, two Dorr clarifiers and five sludge re-aëration tanks. The aërating tanks are 10 ft. wide and 70 ft. long, with a depth of 15 ft., giving a nominal capacity of 75,000 gal. each. The average aërating period, with 20 per cent sludge, is 6½ hr., with a minimum period of 4 hr. The Dorr clarifiers are 50x50 ft. in size, with a 12-ft. depth, having a nominal capacity of 220,000 gal. each. The additional clarifiers are of the same size. The settling period for 20 per cent sludge averages 2 hr., with a minimum of 1.1 hr. The sludge re-aëration tanks, of the same dimensions as the aërating tanks, have an aëration period of 6 hr. on a constant return basis.

When it became apparent that some emergency means of relieving the overloading was necessary, the plates on the 6x6-ft. Dorr screen, which had slots ⅛x2 in. in size, were changed for plates with slots of twice this width. This increased the capacity of the screen from 6 to 10 m.g.d., which is the present nominal screening limit. The capacity was also increased by the building of an additional clarifier and six additional aërating tanks.

With the maximum capacity afforded by these changes, there was still some question about the ability of the plant to handle all the sewage from the area it was originally intended to serve if the present rapid rate of increase continues. Further extension from time to time as the need develops is therefore planned and extensions to certain elements of the plant are now under way.

An 8x8-ft. Dorr screen with ⅛x2-in. slots, having a nominal capacity of 10 m.g.d., is now being installed adjacent to the present screen, the screen house being extended to cover both screens with their appurtenances. With these two screens the plant will have a nominal screening capacity of 16 m.g.d., with an actual capacity somewhat higher than this.

An additional clarifier of the same size as those now in use is under construction and the sludge filtering apparatus will be increased 50 per cent.

Disposal of Sludge and Effluent—The plant is located on the old 540-acre sewage farm owned by Pasadena. About 40 acres of the least valuable land surrounding and including the plant site have been reserved for the plant's use and extension.

The crops are oranges, walnuts, potatoes, beans, corn and alfalfa. Such of the effluent as is not required for irrigation flows miles through a concrete pipe with a capacity of about 36 m.g.d. to the Rio Hondo, a flowing watercourse which joins the San Gabriel River. When rain makes irrigation unnecessary, the entire effluent goes to the Rio Hondo.

All the effluent is chlorinated before leaving the plant. Analyses frequently show no bacteria and at no time does the bacterial count exceed 200 per c.c. Comparative analyses have shown an effluent of much lower bacterial count than the water usually flowing in the Rio Hondo. The original plan was to locate the activated sludge plant on land bought for that purpose and for receiving the effluent known as the Tri-City farm, but litigation has prevented the use of that land for sewage disposal.

The screenings (which, with the ⅛x2-in. slots, amounted to 36 cu.ft. per m.g.) are buried on the farm and the sludge is used thereon as a fertilizer. Plans are being formulated for incinerating the screenings, as burial is expensive and unsanitary.

The settled sludge from the clarifiers is dewatered by two 11½x14-ft. Oliver continuous vacuum filters driven by two 5-hp. motors, with which are used two 14x8-in. duplex dry vacuum pumps. The latter are driven by two 30-hp. motors. The filtrate is handled by two centrifugal pumps driven by 5-hp. and 7½-hp. motors, respectively. The sludge cake from the filters is discharged onto a belt conveyor which delivers it to a storage bin whence it discharges by gravity to dump trucks.

The quantity filtered varies from 0.175 to 0.240 m.g.d., depending on the condition of the filter cloth. These cloths can be used on an average of about 30 days before replacing. The average moisture content of the sludge delivered to the filters is 99 per cent. The dewatered cake from the filters averages about 84 per cent. The sludge is dosed with alum prior to delivery to the filters, the best results being obtained by using 7 to 9 lb. per 1,000 gal. of sludge.

The filter costs have been grouped under four general headings, labor, power, materials, and general expense unclassified. These costs do not include original purchase price of equipment, installation or depreciation. Labor cost for the operation of the filters is $23.65 per 24 hr. and includes the services of four men, three of whom work on an 8-hr. shift basis. Power costs are estimated at $13.98 per 24 hr., based on horsepower of connected load with all equipment being in operation the full time. The cost of electric energy charged against this plant from the municipal power system is about 0.009c. per kw.-hr. Material costs include about 1,600 lb. of alum daily at 1.75c. per lb. or $28 per 24 hr. Filter cloths and wire used in recovering two filters cost $132, or $4.40 per 24 hr. General expenses unclassified are estimated at $100 per year or 32c. per 24 hr. Totaling these several items the cost of operating the filters is $70.35 per 24 hr. Using 200,000 gal. as an average quantity of sludge filtered in 24 hr., the cost per 1,000 gal. of sludge dewatered amounts to 35c.

The total cost of this plant to date is reported as about $532,000, or, on the basis of 55 gal. per capita per day, approximately $4.70 per capita of population served. On a power rate of 0.8 to 0.9c. per kw.-hr. the power consumed amounts to about $11 per m.g. of sewage handled.

The salaries of one superintendent, one assistant superintendent, one chemist, operators, laborers and one machinist and electrician, and miscellaneous labor, amount to $1,900 per month. Exclusive of interest, depreciation and sludge disposal, the cost of operation is rated roughly at $26 per m.g. No credit for fertilizer value of sludge or irrigating value of effluent is included in this figure.

A scheme of ocean sewage disposal for the western portion of Los Angeles County (see *Engineering News-Record*, June 18, 1925, p. 1026) is being developed by the county engineers and Alhambra and South Pasadena have signified their intention of joining this when it is available. When this article was being written it had not yet been decided whether Pasadena and San Marino would also join the county system. Should they do so the treatment portions of the plant would probably be abandoned, some portions of the mains and interceptors becoming part of the county scheme.

R. V. Orbison, formerly city engineer of Pasadena and since 1920 city manager of South Pasadena, conducted tests and made other investigations preliminary to the design of the plant and played a large part in its design. Final design and also construction were under the general supervision of C. W. Koiner, city manager of Pasadena (resigned July 1), E. M. Loraine, city manager of Alhambra, and A. W. Wyman, consulting engineer. E. P. Demey was engineer of construction. G. H. Hooper was responsible for most of the statistical surveys and reports. William J. Fox is city engineer of South Pasadena.

Stone Bridge Piers 80 Years Old Found in Poor Condition

Removal of Cracked Piers of Pittsburgh Bridge Reveals Unbonded Core Held by Face Ashlar

LAST spring, a short time before reconstruction work on the Ninth St. bridge over the Allegheny River in Pittsburgh was to begin, the bridge was reported to be unsafe, because of the dangerously cracked condition of its piers; it was closed for traffic by order of the county commissioners on Feb. 10, 20 days before the time when it would have been closed for reconstruction purposes. There was strong public protest against the closure as unnecessary and unwarranted. In the progress of the demolition of the old structure, however, the condition of the old piers was found to be so bad that the prompt closing of the structure was seen to have been justified.

The piers were built in 1840, and for a long time carried a wooden superstructure. In 1890 a steel superstructure was built on the old masonry; presumably some repairing was done on the piers at this time. The exterior of the piers was ashlar masonry of good appearance, and it was assumed that the interior was of the same construction. Nevertheless, in recent years the piers cracked in a manner quite similar to the cracking of a brick or masonry test pier in the testing machine just before failure. Fig. 1 herewith portrays the condition of pier 2, the second pier from the south or Pittsburgh end of the bridge. Wedges put into the cracks as indicators of enlargement frequently loosened and in some cases dropped out. The pier was banded with steel straps and cables, drawn tight, to bind the pier together. The lower band, which was submerged at high stages of the river, was broken last winter,

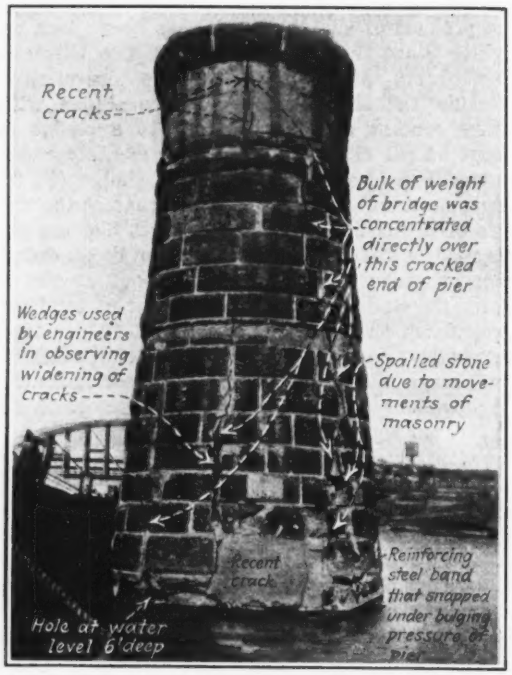

Recent cracks
Bulk of weight of bridge was concentrated directly over this cracked end of pier
Wedges used by engineers in observing widening of cracks
Spalled stone due to movements of masonry
Recent crack
Reinforcing steel band that snapped under bulging pressure of pier
Hole at water level 6' deep

FIG. 1—CONDITION OF PIER OF NINTH ST. BRIDGE, PITTSBURGH

Pier near south end of bridge. For some time it was held together by steel banding, but the outward pressure continued and caused enlargement of the cracks and failure of the bands.

probably by ice impact. The second band from the top, many feet above water level, broke from the unaided bursting pressure of the pier, and it was this breaking that led to the closing of the bridge.

Fig. 2 shows pier 4, near the north bank, during its demolition. This pier was least cracked, and apparently was the strongest. Yet its demolition showed that it consisted only of an outer shell of ashlar masonry, with core of filling consisting of rounded stones laid in uneven courses and very weakly bonded with mortar. The coherence of this core constituted the main supporting strength of the pier, as the cut stone facing was obviously of limited resistance to bursting pressure, which would develop after failure of the core bond. This bursting pressure, coupled with concentration of the superstructure load on the face courses, is to be looked upon as cause of the cracking.

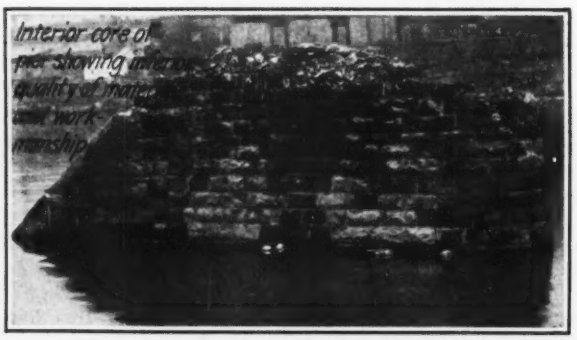


FIG. 2—UNBONDED CORE OF NORTH PIER

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

BERNON BRIDGE, WOONSOCKET, R.I.

Woonsocket, R. I.

CITY IN PROVIDENCE COUNTY, RHODE ISLAND, 16 miles northwest of Providence, on the Blackstone River. Primarily an industrial city busy with the manufacture of worsted goods, but also makes foundry and machine shop products, hosiery and rubber boots and shoes. Settled about 1666; chartered as a city in 1888. Area was increased in 1871 by addition of Smithfield. Pop. (1920) 44,000.

THIRTY years ago when Frank H. Mills was elected the first city engineer of Woonsocket, R. I., Main St. was the only paved street, the water department had just begun to function and there were no sewerage facilities. Mr. Mills is still the city engineer, and his long tenure of office has been one wherein education of the city's inhabitants to the necessity for modern sanitary services and a forward-looking program of municipal improvements has not been least among his responsibilities. Though Mr. Mills has been in office but thirty years, his acquaintance with the city dates from the early eighties. He has seen the city grow from a gawky factory village of 10,000 inhabitants housed mostly in tenements owned by the various textile mills which still are the chief life of the community, to a unified city of some 50,000 persons. And in that growth he has wielded no small influence.

Indicative of the education that has been necessary to equip the city with necessary services but one incident need be cited. In the early eighties, when the water supply was first installed and mains for fire protection were laid, the mayor lived on the hill. He fought the expenditure of so much money for large mains on the ground that not enough force could be secured to give adequate protection. He said that if he could be given a demonstration of adequate pressure his objections would be withdrawn. A stream from a fire hose was therefore turned on his house and when the stream began to tear shingles from the roof of his house he called a halt and admitted defeat. And in trying to convince the people of the need for proper sewerage Mr. Mills has had as difficult a time.

The city lies on hills between which passes the Blackstone River. The original village was a group of mill buildings skirting the banks of the river, and the main street lay between the toe of the hills and the mill buildings. That old original main thoroughfare has become the main street of the city, and the business section has accordingly become congested. The city hall occupies an old mill building and there is not one city department which has enough room. Congestion seems general. Heavy automobile ownership has increased the problem. As an indication Main St. is a one-way street. The steel bridge across the river, the oldest of fifteen principal bridges which the city maintains, allows parking its entire length. The spectacle is an odd one.

And yet the engineering operation of the city is largely a matter of maintenance. It is characteristic of so many New England cities that until a few years ago found the minimum of new improvements sufficient. The automobile has largely changed the situation. Street and bridge maintenance has become more expensive. More streets are required. And the addition of so much new residence property has quickened the need for water and sewer extensions.

Woonsocket has the councilmanic form of government. The council is made up of the board of aldermen and the common council, with the mayor at its head. The city engineer owes his appointment each year to the mayor, subject to the council's approval.

Vagaries in City's Growth—In the addition of new residence property is found one of the chief problems which confront the city engineer. And it has had a marked effect upon the city's growth, in that no uniformity of streets has been possible. When a property owner wishes to cut up a piece of land into homesites, there is no power which requires him to record the new survey. He may sell all of the lots, and though they be in the city limits, the city can do nothing in the matter of making the new streets harmonize as to exact grade, alignment or width with existing public streets. As a result there are almost as many private streets in the city as there are public ones, the division being about 75 miles of public streets and 50 miles of private ones.

However, inasmuch as the city lays water and sewer lines generally only upon streets which have been made public property, sooner or later the property owners ask that a certain street be made public. The street is then surveyed and the notes, together with the city engineer's recommendations and the property owners' application, laid before a highway commission of three disinterested members. This commission examines the property, usually takes cognizance of the city engineer's report and defines the physical boundaries of the new street. It is obvious that such a procedure may lead to great expense in street widening or straightening which could have been avoided when the property was first opened for sale, were there some authority vested in a city commission making adherence to city street standards as to grade, width and alignment mandatory. Mr. Mills cites the example of one plot which had four angles in a 500-ft. street, though one end of the street was easily visible from the other. The reason for such an odd situation was that the owner did not want to cut, even a few inches, into the toe of the slope on his property. Mr. Mills has repeatedly argued the necessity for proper municipal control of such conditions but so far his arguments have been fruitless.

City Engineering Work—Mr. Mills' actual construction work is divided about equally between street and sewer work. Practically all of the streets are stone block on a concrete base, the yardage of that type being approximately 200,000 sq.yd., with penetration macadam and brick running each about one-tenth that amount. There are about 35 miles of sewers in the city, which mileage serves approximately 90 per cent of the population. The sewers are all gravity type, the only pumping

being done is that from the collectors to the filter beds, for disposal is through intermittent filters.

Water—Rather extensive plans for increase in the water supply are under way. Water is taken from one of the tributaries of the Blackstone River about four miles from the city. Gravity mains lead the water to the pumping plant whence it is boosted to a standpipe in the highest point in the city. Pressure in the mains in the principal part of the city is usually 100 lb. per sq.in., but the size of the standpipe is only 3.5 m.g. and the consumption often exceeds that, making a great deal of pumping necessary. The water is chlorinated but not filtered, and is apt to become turbid. On July 7 1.5 in. of rain fell in less than two hours, raising the water 17 in. in the lower reservoir, from which the city supply is directly pumped. Eventually it is hoped that funds can be secured for the installation of new standpipes of a total capacity of around 20 m.g.

The improvements being undertaken at the present time concern the increase in the storage capacity. Several lean years of rainfall have left Mr. Mills rather worried, so the storage dam is being raised 6 ft. and a new concrete corewall will be put in the dam, replacing wooden sheeting used as a cutoff wall. Bids for this improvement were taken July 9. The estimate of cost was around $80,000. With the dam thus heightened the storage capacity will be increased about one-third, giving a storage of nearly 600 m.g.

Woonsocket is another city which has become accustomed to force account work on small jobs. On large projects, where special equipment is needed, contracts are invariably taken. But on small work, except for sewer work, the city uses its own forces. The reason why sewer work is invariably let by contract is found in the following explanation: Up to about 15 years ago the city was putting in all of its own sewer lines, manholes, and other installations. There was a well-pronounced kick registered by a group of local small contractors that the city was invading a private field. The contractors had enough power in the city council to get an ordinance passed making it obligatory that the city let all of its sewer work by contract. That ordinance still stands. Even house connections are contracted for. After the ordinance was passed only one of the contractors who had asked for its passage ever bid, and he executed only one contract.

Garbage collection is done by contract, the contractor maintaining a piggery. Education of the people to the necessity for separating garbage from other refuse availed little, so recently an ordinance was passed making such separation obligatory, failure so to do being punishable by a fine.

Streets and Bridges—The city has laid in the past a considerable yardage of sidewalks of a tar-gravel or tar-cinder type, though the present practice is toward granolithic as a standard. The former was laid where the property (which pays half of the cost of the improvement) could not stand the expense of more costly work. Such sidewalks were built of a 4-in. layer of heavy gravel impregnated with tar, upon which was placed a 1-in. mat of tar and cinders or light gravel. The sidewalk was then rolled. Though inexpensive such walks do not stand much wear as warm weather brings the binder out, after which disintegration is rapid. Walks are now built with a 9-in. broken stone base, a 4-in. concrete top and a wearing surface 1 in. thick of mortar, hand-floated. In the installation of curbing there is a diversion from usual custom in payment; the property owner pays for the cost of the curbing delivered, and the city pays the cost of putting it in.

Though there are fifteen principal bridges crossing either the Blackstone River or the millrace, most of them are stone or concrete, and need little maintenance. The principal bridge is a steel structure. That is inspected at least twice a year. Flooring replacement is the chief item of maintenance.

Though one might suppose that thirty years of continuous service might narrow a city engineer's perspective, it is quite obvious that that is not the case in Woonsocket. On the contrary, Mr. Mills appears to have always been in the front rank, if not the leader, in planning for the future in providing the city with engineering services.

Engineering Work

City Lot and Subdivision Surveys

By W. L. Prouty
Prouty Bros. Engineering Co., Denver, Colo.

As a result of an investigation of the methods used in the larger municipalities of the United States for making lot and subdivision surveys, the data tabulated herewith were secured. These data were obtained by means of a questionnaire sent to the city engineer of each of the various municipalities. The inquiry was made to secure information on these questions:

(1) Are city lot and subdivision surveys made by the city engineer or by engineers engaged in the private practice of engineering?

(2) What is the cost of making the surveys in one city as compared with other large cities?

(3) Is the engineer making the survey required to be bonded or licensed?

(4) How many men are required on lot survey parties?

(5) Is a public record required for each individual lot survey?

In answer to the first question I was surprised to find the practice overwhelmingly in favor of the engineer engaged in private practice. Out of 31 cities only three, Philadelphia, Washington and Cheyenne, have this work done entirely by the city engineer. Philadelphia is divided into 14 districts, each supervised by a surveyor and regulator who has charge of the survey work of every description in his own district. There are five cities where both city and private engineers do the work. In several of these the city engineer is reluctant to do the work and would rather leave it to the private engineer.

The inquiries brought out a considerable variation in the cost of surveys. It is particularly significant that where the city does all of the lot survey work the cost is about 50 per cent of the fees charged by private practising engineers in other cities. Cheyenne is notably low with a cost of only $3 for the survey of a lot 66x132 ft., where three men are required on the survey party. Several of the cities that do either all or part of their own lot survey work are known to have a yearly financial deficit chargeable to lot survey work and yet they have been reluctant to increase their fees to the average standard of other cities that leave this work to the engineer engaged in private practice.

Of the Small City

Several cities base their costs on time required to do the work at so much per hour. Other cities estimate their fees on the basis of the number of lots surveyed or the number of stakes set, etc. Seattle engineers' fees are based on cost plus 10 per cent. Several cities have different fees for vacant lots than for improved property and also different fees for business property than for residence property. Many cities have zoned districts for the establishment of fees, the largest fee being charged for surveys in the business district and the minimum in the outskirts of the city.

This involves another question of interest and that is the basis on which fees are established. Should a fee be for the amount of time involved in making the survey or should it be proportional to the value of the property surveyed?

Often it requires considerably more time to make a survey in the outlying districts—where property is cheap, the survey base line points are difficult to find and the work is inaccessible from an engineering standpoint—than it does to make a survey in the business district where reverse conditions prevail.

In Cincinnati the American Association of Engineers has a printed schedule of fees for civil engineers and surveyors which includes the following:

(1) Lot surveys in the "basin" of the city, $50 per lot.
(2) Lot surveys outside the "basin" and including Norwood, St. Bernard and adjacent villages, $25 per lot.
(3) Staking out buildings without survey, $10 each.
(4) Additional adjacent lots at the same time that lot surveys are made, $5 each.
(5) Legal description of property without survey, $5.
(6) Field work with engineer and two assistants within street car limit, $40 per day.
(7) Additional assistants, $5 per man per day.
(8) Office work engineer $20 per day; assistant $5 to $10 per day.
(9) Subdivision work on per diem basis, by contract or on lump sum.
(10) Farm and other surveys on per diem and expense basis.
(11) Expert testimony and consultation fees, $50 per day.
(12) All construction work in excess of $2,000 to be on basis of 6 per cent of final cost of work.
(13) For furnishing daily inspection on contract work $5 per day for each assistant.
(14) For preliminary plans, specifications and approximate estimates of work not executed, 3 per cent of approximate cost.

The Philadelphia Department of Public Works, Bureau of Surveys, has a printed schedule covering the fees for the following items: lot surveys and regulations, wharf lines, conveyance surveys and plans, grading, street paving and repairing, stoning and surfacing, footway work, sewers, underground pipes and conduits, street railways, measuring masonry, drain pipe surveys.

Another fact disclosed by the inquiry was that a majority of cities do not require the engineer to be licensed or registered and only three require him to be bonded. In my opinion an engineer who makes lot surveys should be both bonded and licensed. The bond is necessary in order to insure the client against possible errors in the survey which might result in damage to property because of the incorrect location of improvements. The engineer should be licensed or registered in order that the client may know that the engineer is qualified to do the work required of him.

It is evident that field parties of four are not necessary in making the average survey. In a party of three the instrumentman being chief of the party keeps his own notes and leaves most of the actual work to the two chainmen. Many times however it is advisable to have a party of four in areas having heavy traffic.

A majority of the cities do not require a public record to be kept of the individual survey. Public records are required however for new subdivisions. A public record should be kept in some form or at least a record which would be available to all of the engineers making lot surveys. Minneapolis requires a plat of survey to accompany each application for a building permit. This practice should be encouraged.

LOT SURVEY DATA IN 31 PRINCIPAL CITIES

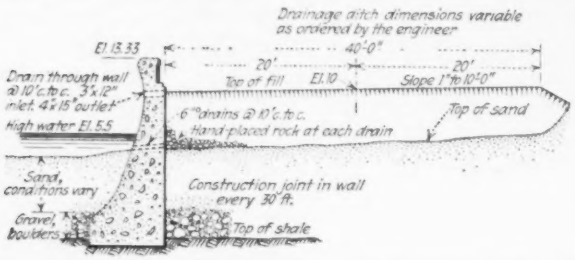
Estimated Population	City	City or Private Engineers	Cost per Lot	Engr. Bonded or Licensed	No. Men or Party	Public Record of Survey
796,296	Baltimore	Private	$25–$30	No	3	Recording optional
783,166	Boston	Private	$10–$25	No	3	Recorded
551,690	Buffalo	Private	Bldg., $12 Vacant, $7	Licensed	3	New subdivision only
15,105	Cheyenne	City	$3 for 66′ x 132′	Licensed	3	Card index
2,995,239	Chicago	Private	Res., $20 Bus., $25	Licensed	2 and up	No
409,000	Cincinnati	Private	$25–$50	No	3 or 4	No
934,358	Cleveland	Private	Based on time	No	3	No
186,423	Dallas	Private		No		
310,000	Denver	Both	$8–$15	Licensed	2 and up	No
148,150	Des Moines	Private	$15 and up	Licensed	2 to 5	No
1,050,000	Detroit	Private	$12 and up	Registered	2 or 3	Few are recorded
163,317	Houston	Both	$12.50–$30	No	4	No
356,980	Indianapolis	Private	$15 and up	Licensed	2 and up	No
314,499	Jersey City	Private	$20 min	Licensed	3	No
365,524	Kansas City	Private	$10 min	No	4	No
60,667	Lincoln	Both	$7.50 min	No	3	City filed—private not filed
711,543	Los Angeles	Private	$20–$30	No	3 or 4	No
498,319	Milwaukee	Private	Res., $10–$15 Bus., $10–$50	No	2 or 3	No
423,396	Minneapolis	Private	$10 min	Licensed	2 or more	Accompany building application
450,786	Newark	Private	$18 min	Licensed	3 or 4	No
413,253	New Orleans	Private	$15 min	Licensed	2 or more	Annexed to acts of sale by notaries
210,772	Omaha	Private	$10–$25	No	2 or more	No
1,979,364	Philadelphia	14 dists. City surveyor and regulator	$8 min	$4,000 bond	4	No
631,563	Pittsburgh	Private	$25–$100	Licensed	3 to 5	No
281,287	Portland	Private	$15–$25	Licensed	2 or 3	No
328,925	Rochester	Private	$15 min	Licensed	2 or more	No
196,401	San Antonio	Private	$10–$15	No	3 or 4	No
130,306	Salt Lake City	Both	$12 min	No	4	Files city engineer's office
555,219	San Francisco	Both	$25 min	City engr. $1,000 bond	4	Files city engineer's office
330,000	Seattle	Private	Cost plus 10%	No	3 or 4	No
450,000	Washington	City	$5–$8	City engr. $20,000 bond	4	Files city engineer's office
	No. of cities — 31	No. private — 23 No. city — 3 No. both — 5	Aver. min. cost — $14.14	No. lic. or reg. — 14 No. bonded — 3 No. not lic. or bonded — 14	Min. in field prty. 6—4 men 13—3 men 11—2 men	Public record — 10 No public record — 20

Seawall Retains Picturesque California Highway

Structure 20 Ft. High and 1¼ Miles Long, Built Along Rincon Cliffs—With Fill Will Replace Old Timber Trestle

By Harlan D. Miller
Bridge Engineer, California State Highway Commission, Sacramento, Calif.

THE seawall being built by the California Highway Commission along the ocean front at the foot of the famous Rincon Cliffs, in Ventura County, 25 miles south of Santa Barbara, is more than half completed. The seawall, which is of concrete, will retain a sand fill upon which the highway will be built and replaces two narrow timber pile trestles which now carry the highway over the ocean beach near the foot of the seacliffs. The wall will be about 1¼ miles in length and averages about 20 ft. in height. It is founded upon a shale rock into which it is set about a foot. It is so located with


Drainage ditch dimensions variable as ordered by the engineer
El. 13.33
40'-0"
20'
20'
Toe of fill
El. 10
Slope 1" to 10'-0"
Drain through wall @ 10' c. to c. 3"x 12" inlet, 4"x 15" outlet
6" drains @ 10' c. to c.
Top of sand
High water El. 5.5
Hand-placed rock at each drain
Sand, conditions vary
Construction joint in wall every 30' ft.
Gravel, boulders
Top of shale

TYPICAL SECTION OF SEAWALL ALONG RINCON CLIFFS HIGHWAY, CALIFORNIA

relation to the cliffs and the paralleling tracks of the Southern Pacific R.R. that it will retain a sand fill 40 ft. wide. A 26-ft. paved highway and a 6-ft. sidewalk will be built upon the sand fill, just back of the wall.

INSIDE COFFERDAM SHOWING FOOTING POURED AND FORM ERECTION

Before the wall was designed a large number of similar structures were reviewed and this wall was made a sort of composite of a number of designs. The seaward face of the wall has been curved to better resist and return the waves. On top of the main structure a parapet wall is being built which will act as a

SEAWALL UNDER CONSTRUCTION: VIEW FROM BLUFFS ABOVE S. P. TRACKS

rail for the sidewalk and at the same time give added protection to the highway from the wave action.

Particular care has been taken in the construction of the wall to secure an impervious concrete so that the action of salt water will be reduced to a minimum. The rock crushing plant, the mixing plant, etc., have all been designed to secure a very dense, strong concrete. Tests made of the field concrete used in the wall have shown an average strength as follows: 10 days, 2,452 lb. per sq. in.; 28 days, 3,914 lb.; 90 days, 5,053 lb.

This wall apparently was not affected in any way by the recent earthquake at Santa Barbara.

The contract calls for about 20,000 cu.yd. of 1:2:4 concrete in the wall proper. The contract price for this concrete is $17.40 per cubic yard.

COMPLETED HALF OF ROAD SEAWALL

The old timber pile trestles which will be replaced by the new wall were built a number of years ago by the citizens of Ventura County, partly financed by private subscription and partly constructed by citizens who volunteered to help in their construction. Under the circumstances the trestles were built as cheaply as possible and because of this fact and also because of their age these trestles have been in a dangerous condition for some time.

The seawall is being built by the J. H. Tillman Co., of Portland, Ore., and will cost, when completed, about $500,000. C. O. Dingle is resident engineer for the California Highway Commission. The work is under the general supervision of the California state bridge engineer.

Sewer and House Connection Lengths at Waltham

The mileage of sanitary sewers in Waltham, Mass., is less than that of house connections, the relative figures being 49.02 and 51.4 on Jan. 31, 1925. There were 67.42 miles of public streets in Waltham on the date named.

Transportation Survey Made for District of Columbia

AT THE instance of the North American Company which has large holdings in the transportation systems in the District of Columbia, the engineering firm of McClelland & Junkersfeld was employed last summer to make an exhaustive transportation survey of the District of Columbia and adjacent section of Maryland and Virginia, under the regulation and supervision of the Public Utilities Commission of the District.

The report of this survey has just been made public in two large volumes of bound typewritten pages. While it makes no recommendations as to revisions of the transportation or traffic facilities of the cities, it affords one of the most elaborate compendiums of data on the subject which has ever been collected for any metropolitan center.

The survey was made by the engineers in co-operation with a committee of experts representing the city engineering department, the Director of Traffic for the District of Columbia, street railways and citizens associations. There were analyzed successively the basic traffic, present traffic flow, present traffic facilities, trend of growth, time studies of operation of the street railway and bus systems, studies of costs and of cost of operation. The report is profusely illustrated with diagrams and maps further explaining the data on the survey.

As stated, there were no general deductions because the report is to be used by the various interested concerns in their studies of revision of the transportation facilities of the city. The following notes regarding the highway traffic conditions are of interest:

The basic survey included 90,000 people employed in government departments and commercial establishments, about 45 per cent of the total employed population. In addition, there are 32,000 casual riders and 15,000 students and teachers. More than 50 per cent of these live within 2 miles of their places of employment, 20 per cent live within 1 mile, and of those residing within 1 mile of their work, 1,600, or nearly 10 per cent, use automobiles as a means of transportation. The effective overall speed of travel between residence and place of business of those whose journey is 2 miles or less is: Walking, 3.7; street railway, 4.1; motor bus, 4.5; private automobile, 5.7 miles per hour. For those whose journey is as much as 6 miles, the overall speed between origin and destination is: By street railway, 7.2; motor bus, 7.5, and private automobile, 10.6.

Based on the average load throughout the day, the automobile requires 46 sq.ft. of street space per passenger against 10 sq.ft. for street cars. On the basis of conditions during rush-hour period, the automobile requires 51 sq.ft. of street space per passenger, while the street car requires 7 sq.ft. In legally designated congested areas, approximately 29 per cent of the roadway area, exclusive of street intersection, is reserved for automobile passengers. In the legally designated congested area, about 22 per cent of the street mileage, exclusive of street intersections, is at such a width as to permit the passage of two lines of moving vehicles in each direction without encroaching on parking area or railway zones. About 22 per cent of the total number of motor vehicles are kept in the public streets at night instead of in garages.

Continuous-Girder Bridges of Concrete

Increasing Use of the Type—Graphical Analysis By a Simple Method Adapted to Variable Moment of Inertia—Adjustment of Supports and Span Length of Three-Span Girder

By J. F. Seiler
Engineer of Bridges, Wyoming Highway Department, Cheyenne

CONTINUOUS-GIRDER bridges have in the past been given scant consideration, especially for concrete construction. At present there is a decided tendency in the direction of their use, however, and it is believed they will become much more popular when their advantages are better realized and their analysis more thoroughly understood. Recent articles including that of I. Duberstein ("Stresses in Continuous Beams Determined Graphically," *Engineering News-Record*, May 28, 1925, p. 886) and that of F. W. Davey (*Engineering and Contracting*, July 22, 1925, p. 206), have sought to throw additional light on this problem, but to the writer it seems that none of the methods described, including those outlined by Dr. D. B. Steinman in the chapter on continuous bridges of Hool & Kinne's "Movable and Long-Span Steel Bridges," clearly set forth the underlying principle utilized in the analysis of continuous beams of more than two spans. It is the purpose of this article to set forth that principle, and by its use develop diagrams which greatly simplify the problem. The funicular or equilibrium polygon of a beam loaded with elastic weights is used as the basis of obtaining the ordinates to the elastic curve of the beam under the prescribed conditions of loading, though it is found more convenient to tabulate the intercepts of the various rays of such a diagram, thus securing accurate results and further simplifying the work.

The discussion will be limited principally to the three-span continuous girder, for the reason that apart from the two-span girder it is perhaps the only one practically applicable to bridges. In multi-span bridges the limit of continuity ordinarily does not exceed three spans, because of expansion joints. In most cases the structure has longitudinal symmetry. In the structure of five, seven, nine or more spans, the designer may provide a middle set of three spans flanked by simple spans or by single or multiple sets of two or three spans of equal length. While the method described applies to non-symmetrical spans, it is not feasible to detail the general case here.

As is well known, the influence line for any reaction of a beam is identical with the deflection diagram produced by removing the support under consideration

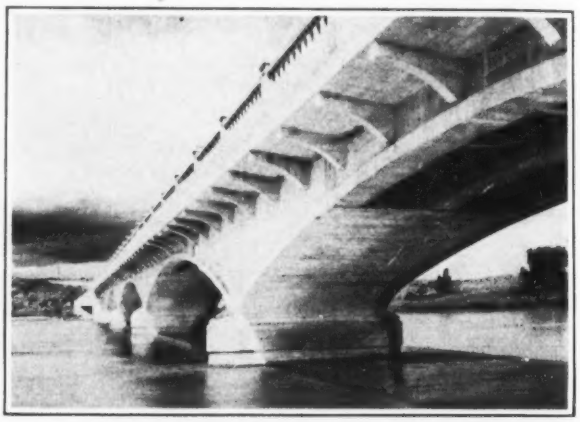


FIG. 1—MODERN CONCRETE HIGHWAY BRIDGE ILLUSTRATING INVERTED T-BEAM CONSTRUCTION

Bridge over North Platte River at Douglas, Wyo.; five spans, total length 417 ft.; completed 1923 by State Highway Department. Lower view of end span.

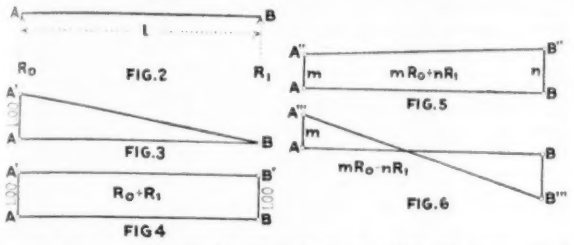
and displacing the beam at that point a distance of one unit in the direction of the reaction. Any other displacement w obviously results in an influence line for the reaction due to a load w, or an influence line for wR for a unit load.

The simplest application of this principle is in the case of the single-span beam AB, Fig. 2. By displacing the beam at A a unit distance the resulting straight line $A'B$, Fig. 3, is an influence line for R_o. Suppose a unit displacement in the same direction be also given the beam at B, Fig. 4, resulting in the line $A'B'$ parallel to AB; obviously this is the influence line for $R_o + R_1$, where at any point $R_o + R_1 = 1$. If displacements m and n be given at A and B respectively, Fig. 5, the resulting position of the beam is the influence line

TABLE I—VALUES OF $R_0 + R_3$ FOR 3-SPAN SYMMETRICAL BEAM
$n = 2$. Ratios of Moment of Inertia varying from 1 to 10

Point	Elastic Weights	Σ Elastic Weights	Distance, Read Down	Difference in Elevation, Read Up	Elevation Above C. L.	Elevation Above Base Line	Ordinates to Unit Scale	R_0+R_3 for k =
R_0	.....		...	21.75	595.75	389.75	1.000	0.0= 1.000
a	0.5	43.5	0.5	43.0u	574.00	368.00	0.944	(End Span)
b	1.0	43.0	1.0	42.00	531.00	325.00	0.834	0.1= 0.889
c	1.0	42.0	1.0	41.00	489.00	283.00	0.726	0.2= 0.780
d	1.0	41.0	1.0	40.00	448.00	242.00	0.621	0.3= 0.673
e	1.0	40.0	1.0	39.00	408.00	202.00	0.518	0.4= 0.570
f	1.0	39.0	1.0	38.00	369.00	163.00	0.418	0.5= 0.468
g	1.0	38.0	1.0	37.00	331.00	125.00	0.321	0.6= 0.370
h	1.0	37.0	1.0	36.00	294.00	88.00	0.226	0.7= 0.274
i	1.0	36.0	1.0	35.00	258.00	52.00	0.133	0.8= 0.180
j	1.0	35.0	1.0	17.00	223.00	17.00	0.044	0.9= 0.089
R_3	.....		0.5	34.00	n=206.00	0.00	0.000	1.0= 0.000
k	3.0	34.0	1.0	62.00	172.00	— 34.00	—0.087	Center Span
l	5.0	31.0	2.0	52.00	110.00	— 96.00	—0.246	0.1= —0.163
m	7.0	26.0	2.0	38.00	58.00	—148.00	—0.380	0.2= —0.317
n	9.0	19.0	2.0	20.00	20.00	—186.00	—0.477	0.3= —0.429
o	10.0	10.0	2.0	0.00	0.00	—206.00	—0.529	0.4= —0.503
C. L.	Σ =43.5	0.0	1.0	Σ = 595.75	0.00	.....	.....	C. L. = —0.529

for $mR_0 + nR_1$, or (Fig. 6) in the case of opposite displacements $mR_0 - nR_1$. Influence lines for reactions of a simple beam are straight lines, because the elastic properties of such a beam have no effect upon the



FIGS. 2 TO 6—REACTION INFLUENCE LINE, SIMPLE SPAN

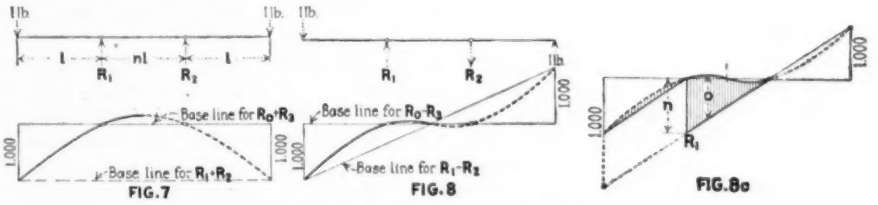
reactions for any loading of the span. Such lines correspond to the equations of statics, which are sufficient for the solution of all simple beams. Any two influence lines, giving at any point of the beam two independent relations between the reactions under consideration, are sufficient to determine these reactions.

Extending this principle first to a continuous beam of two spans with reactions R_0, R_1 and R_2, we find that three influence lines are required, of which two are straight lines and one is curved, the latter involving the elastic properties of the beam. Thus it is plain that for any beam of n spans, $(n + 1)$ influence lines are required to determine the reactions, and two of these are always straight lines corresponding to the static equations. In the analysis of such a beam all of the supports except R_0 and R_1 are removed, thus rendering the beam statically determinate, and a load applied at R_2, giving a deflection diagram or influence line for $c_2R_2 + c_3R_3 + c_4R_4 + \ldots + R_n$ (the displacement at R_n being scaled down to unity). Next the load is applied at R_3, giving an influence line for $k_2R_2 + k_3R_3 + k_4R_4 + \ldots + R_n$, and so on until $(n - 1)$ diagrams are secured, each one giving at any point of the beam one independent relation between the reactions involved. The reactions R_0 and R_1 are of course determined by statics.

This being done, the general principle may then be stated, that *to determine the reactions in any continuous beam, all of the supports except two must be removed and any displacement given. The resulting diagram is a function of each reaction involved, and there are required as many functions as there are reactions to be determined. The force or forces producing the displacements must be applied at the points of the removed supports.*

Three-Span Girder—In coming to the symmetrical three-span beam or girder, it is assumed that variations in section are also symmetrically disposed. Such an arrangement is practical, meets architectural requirements and simplifies the procedure. In this case (Figs. 7 and 8) the supports R_0 and R_3 are removed and a unit load is applied at both of these points; when these loads act in the same direction we get the influence line for $R_0 + R_3$, while when one of the unit loads is reversed the influence line is for $R_0 - R_3$. Since these diagrams are symmetrical, it is necessary to construct only half of each diagram.

Obviously the same diagrams are influence lines for R_1 and R_2 through changing the base lines, giving (Fig. 7) the influence line for $R_1 + R_2$ and (Fig. 8) the influence line for $R_1 - R_2$. In the latter case, however, all the intercepts are multiplied by the factor 3 (for equal spans).



FIGS. 7 TO 8—THREE-SPAN GIRDER

Influence lines for sum and difference of end reactions. Fig. 8a shows shear in middle span. For maximum shear at R_1 the adjacent spans are loaded. Shear at any point is o/r. The hatched area in Fig. 8a is the total shear at R_1.

All the displacement diagrams are the equilibrium or funicular polygons of the beams, and for trusses, Williot diagrams. In this article only beams or girders, in which deflections due to shearing forces may be neglected, will be considered. The values of $R_0 + R_3$ or $R_0 - R_3$ may best be tabulated, rather than scaled from a diagram. The work then becomes a routine process, accurate and easily checked.

The force diagram, consisting of the successive elastic weights taken from the $\frac{M}{I}$ diagram, is constructed for half of the beam, and a pole distance of unity is

TABLE II—VALUES OF R_0—R_3 FOR 3-SPAN SYMMETRICAL BEAM

$n = 2$. Ratios of Moment of Inertia varying from 1 to 10

Point	Elastic Weights	ΣElastic Weights	Distance, Read Down	Difference in Elevation, Read Up	Elevation Above C. L.	Elevation Above Base Line	Ordinates to Unit Scale	R_0—R_3 for k =
R_0	.....	...	...	9.25	180.75	98.75	1.000	0.0= 1.000
a	0.5	18.5	0.5	18.00	171.50	91.55	0.927	End Span
b	1.0	18.0	1.0	17.00	153.50	77.65	0.786	0.1= 0.857
c	1.0	17.0	1.0	16.00	136.50	64.75	0.656	0.2= 0.721
d	1.0	16.0	1.0	15.00	120.50	52.85	0.535	0.3= 0.596
e	1.0	15.0	1.0	14.00	105.50	41.95	0.425	0.4= 0.480
f	1.0	14.0	1.0	13.00	91.50	32.05	0.325	0.5= 0.375
g	1.0	13.0	1.0	12.00	78.50	23.15	0.234	0.6= 0.280
h	1.0	12.0	1.0	11.00	66.50	15.50	0.154	0.7= 0.194
i	1.0	11.0	1.0	10.00	55.50	8.35	0.085	0.8= 0.120
j	1.0	10.0	1.0	4.50	45.50	2.45	0.025	0.9= 0.055
R_1	.....	...	0.5	9.00	a= 41.00	0.00	0.000	1.0= 0.000
k	2.0	9.0	1.0	14.00	32.00	— 4.90	—0.050	Center Span
l	2.0	7.0	2.0	10.00	18.00	—10.70	—0.108	0.1= —0.079
m	2.0	5.0	2.0	6.00	8.00	—12.50	—0.127	0.2= —0.118
n	2.0	3.0	2.0	2.00	2.00	—10.30	—0.104	0.3= —0.116
o	1.0	1.0	2.0	0.00	0.00	— 4.10	—0.042	0.4= —0.070
C. L.	Σ =18.5	0.0	1.0	Σ =180.75	0.00	0.00	0.000	Σ = 0.000

TABLE III—VALUES OF ALL REACTIONS FOR 3-SPAN SYMMETRICAL BEAM

$n = 2$; Ratio of I varying from 1 to 10

Point	R_0+R_3 (Table I)	R_0-R_3 (Table II)	R_0	R_3	$R_1+R_2 = 1-(R_0+R_3)$	$R_1-R_2 = 2\ y-(R_0-R_3)$	R_1	R_2
$k=0.0$	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000
0.1	0.889	0.857	0.873	0.016	0.111	0.186	0.149	−0.038
0.2	0.780	0.721	0.751	0.030	0.220	0.358	0.289	−0.069
0.3	0.673	0.596	0.635	0.039	0.327	0.508	0.418	−0.091
0.4	0.570	0.480	0.525	0.045	0.430	0.640	0.535	−0.105
0.5	0.468	0.375	0.422	0.047	0.532	0.750	0.641	−0.109
0.6	0.370	0.280	0.325	0.045	0.630	0.840	0.735	−0.105
0.7	0.274	0.194	0.234	0.040	0.726	0.912	0.819	−0.093
0.8	0.180	0.120	0.150	0.030	0.820	0.960	0.890	−0.070
0.9	0.089	0.055	0.072	0.017	0.911	0.990	0.951	−0.040
1.0	0.000	0.000	0.000	0.000	1.000	1.000	1.000	0.000
Area	0.474	0.418	0.446	0.028	0.521	0.664	0.593	−0.072
0.1	−0.167	−0.079	−0.123	−0.044	1.167	0.958	1.063	0.105
0.2	−0.313	−0.118	−0.216	−0.098	1.313	0.836	1.075	0.239
0.3	−0.429	−0.116	−0.273	−0.157	1.429	0.632	1.031	0.399
0.4	−0.503	−0.073	−0.288	−0.215	1.503	0.346	0.925	0.579
0.5	−0.529	0.000	−0.265	−0.265	1.529	0.000	0.765	0.765
Area	$-0.168n$	$-0.039n$	$-0.104n$	$-0.064n$	$0.668n$	$0.327n$	$0.498n$	$0.171n$

y in column for R_1-R_2 = difference between base lines for (R_1-R_2) and (R_0-R_3).

taken. Thus the summation of the elastic weights from the center of the beam to any point gives the tangent of the angle made by the corresponding ray of the diagram. This multiplied by the distance between elastic-weight load points gives the increment of the ordinate to the elastic curve (or to the vertices of the tangents to the curve) between corresponding points (compare moment-area theory). Let the ordinate to the curve at R_1 be called a, and that at R_0 be called $(a + b)$, Fig. 9. Then, for a unit load at any point $(o - a)/b = R_0 + R_3$. Similarly values of $R_0 - R_3$ are tabulated, proper provision being made for the base line (Fig. 10, compare with Fig. 8). It must be remembered that load points correspond to the vertices of the tangents to the influence curve, consequently a last column must be added in which values are interpolated for points on the curve itself.

In Fig. 11 there is considered a three-span continuous beam, with n as the ratio of center to end spans, and with moment of inertia of the beam varying as indicated from 1 to 10. The values used are taken for simplicity, but in a general way they approximate a practical case. The beam is shown with unit loads at R_0 and R_3 (supports removed) acting in the same direction, below it is the moment diagram, below this the I diagram, and at the bottom the $\frac{M}{I}$ diagram. Fig. 12 gives the corresponding diagrams for unit loads acting in opposite directions at R_0 and R_3. Tables I and II give in the last column the ordinates of the elastic curve or influence line for the sum and difference respectively of R_0 and R_3 for a value of $n = 2$; R_0 is always equal to the half sum and R_3 the half difference of corresponding ordinates. In Table III are given the values for all reactions, also areas under the influence lines for computing reactions due to uniform loading.

Explanation of Tables—The use of the tables may be explained in detail as follows: For Tables I and II the points a, b, c, etc., in the first column are the mid-points of the elastic-weight divisions of each span, which are assumed to be at the line of action of these weights. In the next column are tabulated the elastic-weight areas taken from the $\frac{M}{I}$ diagrams. In the third column, starting from the center line of the beam at the bottom of the table, the elastic weights of Col. 2 are tabulated in summation. In the next column is the distance between the center points of elastic weights. In the fifth column is the product of Cols. 3 and 4, and in Col. 6 the figures of Col. 5 are summed up, giving the total difference in elevation from the center of beam to the end support, the figure opposite R_0 being equal to $(a + b)$ as in the text. The next column gives the values of the ordinates less (a), the ordinate opposite R_1. In the next column are the ordinates divided by (b), which reduces them to unit scale. As these represent the ordinates of the vertices of the tangents, the last column is added, in which the values of the ordinates to the curve itself are given. Table III gives in the second and third columns the values of $R_0 + R_3$ and $R_0 - R_3$ respectively, taken from the tables above, and from which the values of R_0 and R_3 are obtained and tabulated in Cols. 4 and 5. Similarly, in the last two columns of Table III, R_1 and R_2 are tabulated, their values being determined from the values of $R_1 + R_2$ and $R_1 - R_2$ appearing in the preceding columns. It will be noted that the areas under the influence curves for R_0 and R_3 are taken directly from the values of the combined reaction areas of the preceding columns, as greater accuracy is obtained because the separate reactions are computed to the nearest decimal in all cases, and some error is introduced in summing them up. Values for areas of R_1 and R_2 are handled similarly.

The fixed points in the central span of a symmetrical three-span beam are located as follows: The proportion of the two segments of the central span, or $x/(nl - x)$ is equal to $(R_0 + k - 1)/R_3$, where R_0 and R_3 are

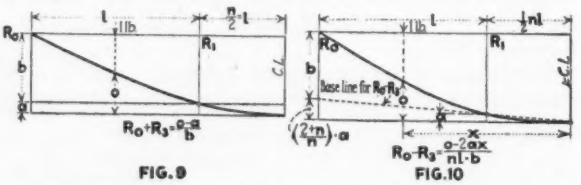


FIG. 9 FIG. 10

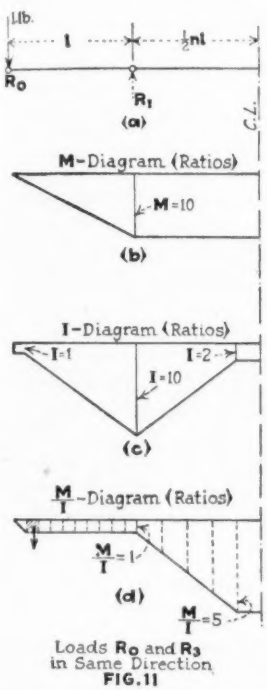
FIGS. 9 TO 10—METHOD OF USING FORCE DIAGRAMS

the end reactions for a unit load placed at a distance kl from the end of the end span.

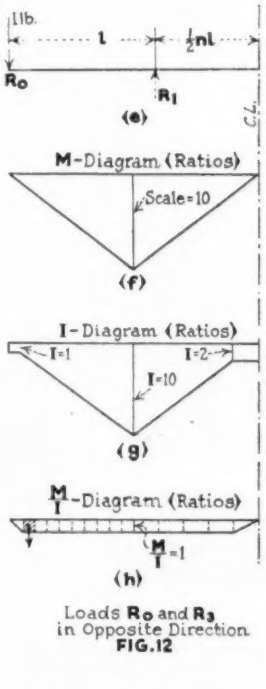
Shear—Shears in a three span symmetrical beam are determined from the influence lines for the various reactions. In the end spans the shear is obtained from the influence line for R_0, while in the central span the value of $R_0 + R_1$ is required for this purpose. It is clear that the value of $R_0 + R_1$ may be obtained from the curve representing $R_0 - R_3$, Fig 8, through changing the base line as shown in Fig. 8a. The ordinate at R_1 will be n, consequently any ordinate or area taken

must be divided by this ratio. That the new base line gives the influence for $R_0 + R_1$ may be shown from the fact that the beam now is displaced equally at R_0 and R_1 with respect to R_2 and R_3, and the displacement diagram consequently is a function of R_0 and R_1 where the coefficients and signs in these cases are the same.

Adjustment of Supports—It is obvious that in a continuous beam the positive and negative moments are greatly influenced by varying the section of the beam.



Loads R_0 and R_3 in Same Direction
FIG. 11



Loads R_0 and R_3 in Opposite Direction
FIG. 12

FIGS. 11 TO 12—CONSTRUCTION OF M/I DIAGRAMS

Moments are increased over the supports where the section is usually greater and decreased correspondingly in the regions of positive bending where the sections are reduced. In order to maintain a desired relation between the sections of the beam and at the same time control the stresses, the adjustment of the supports offers advantageous means of accomplishing this purpose.

In the symmetrical three-span girder the intermediate supports may be lowered to relieve the negative moments or raised to relieve the positive moments. It is usually advantageous, however, to lower the intermediate supports, thus reducing the negative moments at these points. Where the ultimate excess settlement of the piers over that of the abutments may be estimated, as in cases of pile foundations or yielding soil, adjustment of the supports and the design of the beam may well take this factor into account with a view to producing a structure which will not decrease in strength as settlement progresses. The end bearings of the structure may be designed so as to permit of adjusting at later periods if necessary, particularly in cases where settlements have not been uniform or as expected from preliminary investigations In this respect the continuous-girder type of bridge structure enjoys a distinct advantage over the fixed arch type of construction in which no adjustment is possible to take care of progressive settlement of the foundations. Thus the hazard of so-called "soft foundations" for continuous structures is largely discounted.

The relieving moment produced at the intermediate supports by lowering the beam at both those points a distance D is

$$M = \frac{cE}{\sum \frac{xdx}{I}} D$$

where the summation is carried from the center of the center span to the intermediate support; c is the center ordinate of the influence line for $R_0 + R_1$; x is the distance from the center of each division of the $\frac{M}{I}$ diagram to the intermediate support; and dx is the width of each $\frac{M}{I}$ division. The lowering of the intermediate supports is best accomplished by jacking up the beam at the end bearings and adjusting its elevation as may be required, since expansion devices which readily permit of adjustment are usually located at these points, while at the intermediate supports the girders, if of reinforced concrete, are frequently in direct contact with one or both supports, where part of one pier may be utilized as a rocker.

Span Length—The length of spans practical for continuous structures of reinforced concrete is limited principally by weight and the possibility of providing proper expansion devices. However, for highway bridges it is well within the limits of conservative design to construct girders of spans up to 100 ft., particularly where clearances permit deck construction. In such cases much economy may be gained through T-beam design, with compression flange reversed (or the beams inverted) through the regions of negative bending. By this means a considerable degree of stiffness is also obtained, adding materially to the rigidity of the structure.

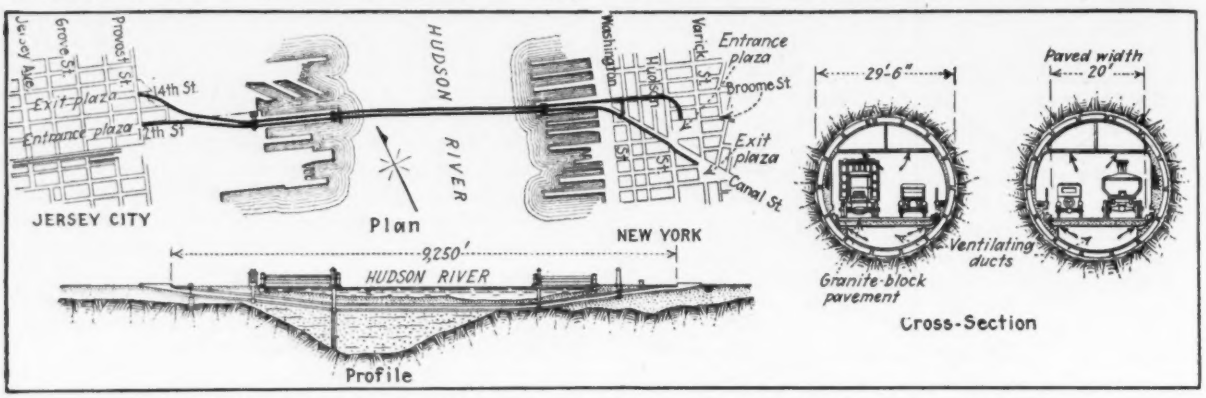
The writer has designed such a type in the reinforced-concrete bridge over the North Platte River at Douglas, Wyo., completed in 1923 by the State Highway Department. The three central spans of this structure are 94, 95 and 94 ft. respectively. Where the section is variable another source of economy lies in the fact that the heavier sections are over the supports, which means reduced dead-load moments. In long-span continuous bridges, where the girders themselves make up a relatively large portion of the dead load, this is a factor of considerable importance in reducing the cost as well as in enhancing the general appearance of the structure.

In the field of reinforced concrete as a material of construction the continuous girder merits a place, particularly as compared to the arch. The use of the latter should be confined more strictly to locations where topography, span requirements and suitable unyielding foundation conditions demand its selection. In late years however it has invaded ground far afield from that which time honored custom and practice have allotted it, largely no doubt because bridge designers have been slow to apply the principles of architecture and esthetics to structures depending on beam action for their existence and service, through which the fundamental conception of bridging an opening is perpetuated.

Vehicle Tunnel Under Hudson River Paved with Granite

Shallower Block Than Standard Specified—Asphalt Mastic Joint Filler and Cement-Sand Cushion Used

PAVING the roadways of the Holland tunnel, the $42,000,000 twin-tube route underneath the Hudson River between New York and Jersey City, was begun Sept 14, with granite block specified as the paving material to meet the special conditions of long life and minimum maintenance and repair demanded for the two subaqueous roadways designed to carry a maximum daily traffic of 46,000 motor cars and trucks. Each tunnel consists of the approaches excavated in open cut and of steel bent reinforced-concrete construction and the shield section driven under compressed air. The shield section has an external diameter of 29 ft. 6 in. and is of the cast-iron segmental ring type lined with concrete and finished with glazed tile. Separate inlet and exhaust ventilating ducts for changing the air in the tunnel 42 times every hour occupy the upper and lower portions of the circular section, as shown in the accompanying drawing. The foundation for the granite block pavement in the approaches consists of reinforced-concrete slabs and in the shield-driven section is a series of thick reinforced-concrete slabs between transverse I-beams spaced 5 ft. on centers; this foundation slab serves also as the roof of the lower or fresh-air ventilating duct.



LOCATION PLAN AND DETAILS OF TUNNEL SECTION AT HUDSON RIVER CROSSING

Unit Prices—The paving of the tunnel roadways, each 20 ft. wide between curbs, was awarded as a separate contract to W. J. Fitzgerald, New York. The area to be paved totals 45,000 sq.yd. at a unit price of $7.39 per square yard; the estimated total value of the contract, including minor items of about $800, is $329,655. There were five bidders on the contract, the unit prices for the granite block paving ranging from a low bid of $7.39 to a high bid of $8.25 per square yard. The concrete foundation is not included in the contract and the unit prices cover a 1-in. cement-sand cushion course, furnishing and laying the granite block, and the application of an asphalt mastic joint filler and thin surfacing, finished with a sprinkling of fine sand.

Size of Block—To meet clearance requirements in the tunnel (13 ft. 6 in. from top of pavement to roof) it was necessary to specify a somewhat shallower block than the standard. For the tunnel work, the allowable block dimensions are as follows: Length, 7 to 11 in.; width, 3¾ to 4½ in.; depth, 4 to 4½ in. These compare with the following dimensions for the ordinary standard 5-in. block: Length, 8 to 12 in.; width, 3½ to 4½ in.; depth, 4¾ to 5½ in. The vehicular tunnel granite blocks run from 32 to 34 blocks per square yard as against about 30 blocks per square yard for the standard size. The block for the tunnel paving comes from the quarries in Maine of the Booth Bros. & Hurricane Isle Granite Co., at Long Cove, and J. Leopold & Co., Vinal Haven, whence it is shipped to New York in barges and delivered from the water-front receiving point to the job in motor trucks. The block is required to meet the following standards (A.S.T.M.):

Per cent of wear, not more than 3.6
French coefficient of wear, not less than 11
Toughness, not less than 9

The requirements for smoothness are more severe than in the case of the standard block. For the tunnel blocks the maximum allowable depressions in the surface, measured from a straight-edge laid in any direction along the top of the pavement, are ¼ in. as against ⅜ in. in the standard block.

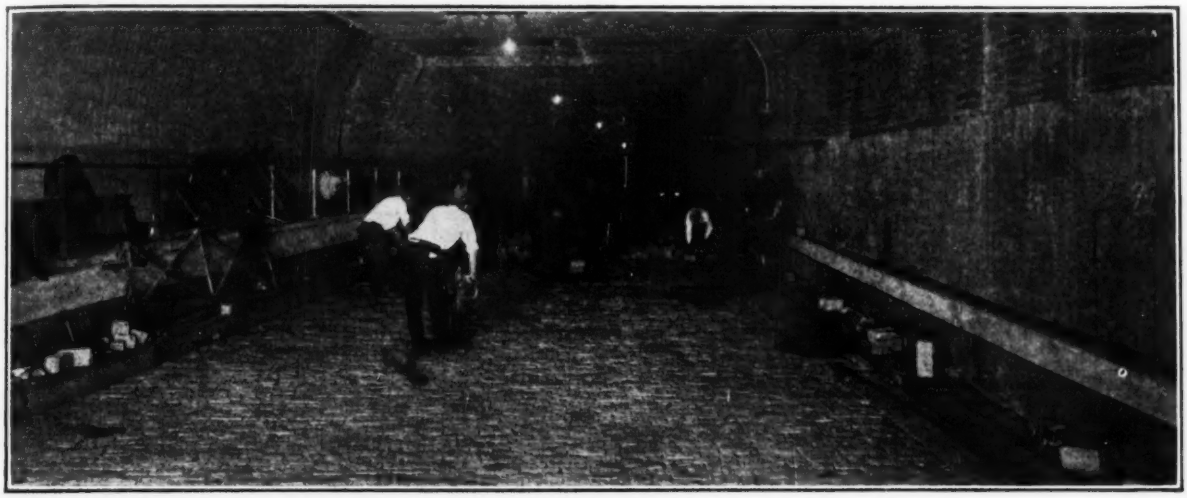
Joints—The maximum width of joints between adjacent rows of blocks is ⅜ in. at the top and for a distance of 1½ in. down and ¾ in. at any other point. This insures a closer jointed pavement than the standard where ordinary specifications permit a joint not exceeding ½ in. at the top.

MIXING EQUIPMENT FOR ASPHALT MASTIC JOINT FILLER

No blocks in any row are allowed to vary more than ¼ in. from the selected width. End joints must be broken by a lap of at least 3 in.

Construction Methods—As the reinforced-concrete foundation had previously been constructed, the paving contract includes the spreading to a thickness of 1 in. of a 1:3 cement-sand cushion, furnishing and laying the blocks and jointing them with an asphalt-mastic filler. The pavement is uncrowned and has a slope toward one side of ½ in. in 20 ft. The cushion course sand is added and the materials mixed by revolving paddles on a shaft driven by an electric motor. The mixture is then discharged into wheelbarrows, from which it is flushed onto the granite block surface and squeegeed into the joints, the excess forming the thin, asphaltic surfacing previously referred to. The finishing process involves an application of sand forming a surface mat for traffic.

The paving materials are delivered into the tunnel by motor truck and stockpiled ahead of the finished work.



LAYING GRANITE BLOCK FOR 20-FT. VEHICLE TUNNEL ROADWAY

is mixed by hand and spread not further ahead of the block laying than can be covered in a day's work. The cushion course is slightly dampened before the granite blocks are placed upon it.

The blocks are set in the usual manner, in rows at right angles to the direction of traffic and then rammed to a solid bearing. Before the jointing material is applied any low or high blocks are removed by tongs and reset to proper grade.

Mastic Joint Filler—For the joint filler an asphalt mastic is specified, consisting of 1 part sand to 1 part asphalt, applied hot. The practice is to flush the asphaltic mixture on the surface and push it into the joints with squeegees, using an excess of material to form a thin film of asphalt on the top surface of the block. This accomplishes two results: First, it increases the smoothness of the surface by filling in depressions, and, second, provides a resilient blanket which will deaden the noise of traffic.

The specifications call for the sand in the mastic to be heated to from 300 to 325 deg. F. and for the asphalt to be heated to 325 deg. F. The asphalt is required to have a penetration of not less than 10 at 35 deg. F. and between 50 and 70 at 77 deg. F.

In order to keep the tunnel clear of smoke and fumes, the contractor was required to heat both his asphalt and sand outside and to deliver them hot to the job. Hot asphalt is delivered in motor truck tank-wagons and from them transferred to a 500-gal. heating kettle warmed by an oil burner and fitted with air agitation inlets fed by a small compressor run by electric motor. The advantages claimed for air agitation during heating are that it does away with coking, overheating, carbonizing and burnt-out bottoms.

From the kettle hot asphalt is drawn off to the drum of a portable mixer, where the required batch of hot

Work is at present under way in the north one of the twin tubes and will be begun in the south tube at an early date. The total length of the tunnel between grade points is 9,250 ft. One of the contract requirements calls for the maintenance of the pavement by the contractor without charge for one year after date of completion.

The Holland tunnel is being built under the joint direction of the New York State Bridge & Tunnel Commission and the New Jersey Interstate Bridge & Tunnel Commission, for which Ole Singstad is chief engineer and Col. F. A. Snyder, engineer of construction. R. Smillie is engineer of design and M. I. Killmer resident engineer. For the granite block paving the contractor is W. J. Fitzgerald, New York City.

Progress on Reclamation Dams

Recent progress on the three large dams of the Bureau of Reclamation now under construction is reported as follows in the *New Reclamation Era* of October: At American Falls dam, Idaho, concreting on the gate section within the cofferdam was completed to El. 4300 during September, and work was begun on the left penstock section, the gate frames for the penstock openings here being placed. Excavation for the core-wall foundation of the right embankment is going on, and embankment material is being placed and rolled. At Guernsey dam, Wyoming, the diversion tunnel was extended by 219 ft., and excavation was in progress for the foundation trenches of the cutoff walls and for the spillway on the north side. At McKay dam, Oregon, the total embankment material at the end of September amounted to 1,960,000 cu.yd., placed at a cost of 42c. per yard; the September contribution was 132,000 cu.yd., costing 50c. Rock excavation was in progress in the spillway channel and at the spillway gate site.

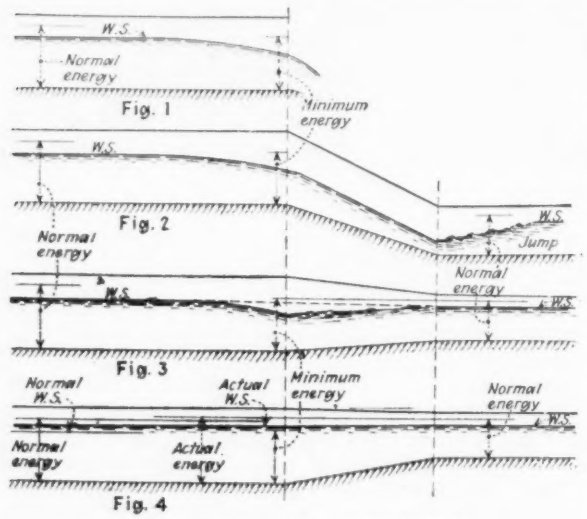
Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

An Aspect of the Hydraulic Jump Problem

Sir—From the point of view of the designer who wishes to avoid hydraulic jumps in his transitions, this somewhat mysterious subject may be considered as follows:

If a flume is open at the end and discharges freely into air, Fig. 1, Mr. Hinds's article of Nov. 25, 1920, p. 1034, implies that the water leaves the flume with critical velocity, critical depth and minimum energy of flow. This minimum energy may be found by trial, for the particular quantity of water flowing, by calculating the depth plus velocity head (energy of flow) for different assumed velocities. The minimum value found corresponds to critical velocity and critical depth. This case of free discharge does not seem to have



HYDRAULIC JUMP IN CHANNELS
Figures do not show grades or friction losses.

been verified experimentally, but the theory is irreproachable and may be considered to hold.

Consider now a transition as shown in Fig. 2. The excessive drop in bed allows the flume still to discharge with its free or spouting velocity, and a jump is formed in the canal. Its position may be located as shown by Mr. Hinds. The height to which the water rises in the jump is the normal height of flow in the channel and depends only on the grade, roughness, section, and quantity of water. The jump is objectionable as the real transition section does not start till the jump is passed.

If now we raise the channel bed, the conditions of flow will change until the "spouting" at the end of the flume is finally drowned, and the transition behaves in a normal manner. This state is represented by Fig. 3 which of course would be unstable and the water surface would follow the dotted line.

Transitions in which the designer suspects that a jump may occur from some unforeseen circumstance are apt to be a nightmare and what is wanted is a simple test for their examination from this standpoint. Fig. 3 supplies the elements of the test and so long as the flow-energy level in the outlet channel is as high as the minimum energy level at the end of the flume, the conditions for jump can not obtain, and ordinary hydraulics will serve to design the transition.

As a factor of safety against jump conditions, the energy level in the outlet channel should be kept as high as possible in cases where there is any doubt. This will necessitate a greater freeboard in the lower reach of the flume, but this is not as objectionable as undue turbulence and scour in the channel may be; see Fig. 4.

A word of warning. The minimum energy should be calculated for several points in the transition and that which shows the highest energy level taken as the control and not necessarily the end of the flume.

This investigation is the outcome of Mr. Hinds's theory and would be of much greater use if some hydraulic laboratory would check it experimentally.

Hobart, Tasmania, Australia, Sept. 8, 1925. A. P. FLOCKART.

Parabolic Sections for Banked Curves

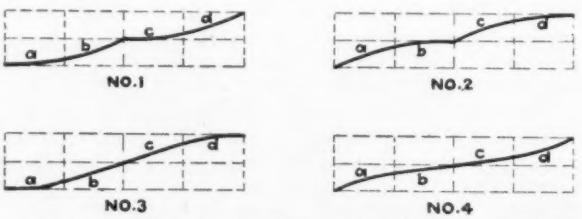
Sir—With reference to a letter from E. G. Walker, *Engineering News-Record*, Oct. 1, 1925, p. 559, regarding parabolic sections for banked curves, I would like to say that there are four possible combinations for a two-track pavement so shown by Figs. 1, 2, 3 and 4.

From the safety standpoint we have two things to consider: Where are the vehicles, going in opposite directions, when they pass and what effect does the bank have on them when they are forced to turn away from the center of the highway?

If we divide our roadway into four strips each 6 ft. wide we can readily see that a vehicle traveling in *a* will not interfere with one going in the opposite direction in *c* or *d*, but a vehicle in *b* may interfere with one in *c* and each will probably have to turn away from the center of the pavement. It is obvious that the section which will place the fewest vehicles in *b* and *c* will probably be safest.

On our country highways the fast-moving traffic is several times as plentiful as the slow-moving and if that is true then the safest section is section 4 which puts the slow-moving traffic all near the center. This section however, has some disadvantages, one of which is that slow-moving traffic in *b* which is forced away from the center is not helped back by the bank and if we examine sections 2 and 3 we find that the fast-moving traffic in *c* when forced away from the center would not tend to come back to normal position as the farther from the center it moved the less bank it would have.

If we examine section 1 we find that fast-moving traffic in *b* and slow-moving traffic in c would both tend to return to normal position due to decrease in bank in one case and to increase in bank in the other. We also find that section 1 is easiest to build as either side can be built first and only one screed is needed. Section 2 cannot be built by the ordinary methods. Section 3 needs two screeds and the upper



FOUR COMBINATIONS FOR A TWO-TRACK PAVEMENT

side must be built first. Section 4 needs two screeds and the lower side must be built first.

All things considered section 1 seems to be the most practicable and safest.

We do not expect two vehicles going in the same direction to pass on a curve and therefore the advantage of having the slow traffic on the outside is not apparent.

Utica, N. Y., Oct. 3, 1925. C. J. MYERS, Senior Assistant Engineer, Bureau of Highways, New York State.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Diamond Creek Project on Colorado Opposed

Upper and Lower Basin States Object to Grant of Girand Application by Power Commission

Washington Correspondence

After a two-day final hearing on the application of James B. Girand of Phoenix, Ariz., for power rights on the Colorado River at Diamond Creek, the Federal Power Commission took the case under advisement. An immediate decision is not expected. Some think it may be a matter of weeks before the Commission announces its conclusions.

Such uniform opposition to the granting of the Girand license came from all of the states in the Colorado River basin that it is recognized that an unusual amount of political courage would be required to order the license issued. On the other hand the attorneys for Mr. Girand contended that their client had complied exactly with the water-power act. Under those conditions, they argued, a license may not be withheld legally.

On the eve of the hearing the United States Geological Survey issued a report by E. C. LaRue, one of its engineers, recommending a dam which would flood out the proposed dam at Diamond Creek. Before the hearing was ended the state of Arizona formally filed an application for federal rights covering such a project.

Rights of the States

The representatives of Mr. Girand contended that the rights of all the states could be protected by including conditions in the license. It was argued that any protection granted by the Colorado River compact would thus be made to apply to his development. L. Ward Bannister, representing Colorado, declared that any such waivers could not bind the commission or the applicant and that they left the third parties to the agreement without recourse in law. He urged that no action be taken until the compact has been ratified by all of the states. He predicted that Arizona would ratify it at the next session of its legislature.

The representative of Governor Hunt, of Arizona, opposed any private development on the river in Arizona on the ground that the state is preparing to undertake it. The attorney general of Arizona contended that Mr. Girand had forfeited his state rights. This Mr. Girand denies. It is his position that he began work on the project within the limits of his state permit, but was stopped by a federal injunction, issued at the request of the Federal Power Commission.

George L. Maxwell opposed the Girand license on the ground that it will interfere with the high-line gravity canal intended to furnish water for irrigation purposes.

The contention on behalf of California among other things was that the Girand development would skim the cream from the market power and thereby would delay the construction of the Boulder Canyon dam for an indefinite period.

Representatives of the Imperial Valley argued that the development at Diamond Creek would increase the low water flow of the river and give Mexico a claim on a larger amount of water.

Governor Nellie T. Ross, of Wyoming, was firm in her insistence that no rights be granted until the compact is signed. Wyoming is high now, she said, and can take no chances on being high and dry too. Former representative Frank Mondell contended that Congress in authorizing the Colorado River Commission had taken the Colorado River out of the hands of the Federal Power Commission. He argued that the latter has no authority to act until the compact is accepted or rejected.

A few days before the hearing, on Oct. 17, the water commissioner of Arizona had canceled the permit granted to Girand and the Colorado River Engineering and Development Co. in 1922 for construction of a power dam at Diamond Creek. This action was in conformity to an opinion rendered by the state attorney-general that construction had not been begun within the time specified in the permit.

Engineering Fifty Years Ago

From *Engineering News*, October, 1875

ON ACCOUNT of the cheapness of building material and labor the past season, an unusual number of buildings have been erected. They are, of course, of stone, brick and iron, and each one has contributed to increase the safety of the city against fire. The result of so much building has been to cheapen rents, which are now exceedingly low, and which, taken with the low prices of other necessaries of life prevailing, makes Chicago a very cheap place to live in, and this fact has become so well known that the increase in population of past years continues, and thus tends to keep trade brisk in these dull times.

Railroad Proposed for Oklahoma

The Oklahoma & Rich Mountain Railroad Co. has applied to the Interstate Commerce Commission for authority to construct a railroad from Page to Talihina in Le Flore County, Okla., a total distance of 35 miles.

Public Health Association Meets at St. Louis

Sanitary Engineering Section Becomes Public Health Engineering—Other Sections Active

Most important to engineers in the way of action taken at the St. Louis meeting Oct. 19, 20, 21 and 22 of the American Public Health Association, was the vote of the Sanitary Engineering Section to drop the name sanitary and make it public health engineering. Leading to the adoption of the more inclusive name is the appropriation of the name by plumbers and the additional features now covered and allocated by the doctors to engineers other than water, sewage and garbage, such as air conditioning and ventilation, mosquito control, milk, oyster and other food stuff handling, and all environmental conditions affecting health. The official change had to be made by the governing body and in order to be done according to by-laws takes the form of the formation of a new section with which the sanitary engineers are to be amalgamated. This action was forecast in a paper by George A. Fuller on "The Place of Sanitary Engineering in Public Health Activities," in which he pointed out the broadened field for the engineer in public health work and the variety of his activities in that field. Action by the main body of the A.P.H.A. called for centralization to be attained by the foundation of four district officers. Mr. Fuller explained that the association had a 25 per cent increase in membership but was only holding its own in total number (about 3,000). He analyzed the cause as not enough individual contact which district offices would furnish. An increase in budget from $75,000 to $95,000 is necessary to effect the district place.

Federal Health Activities

A resolution passed at the convention would segregate public health work of the government and obtain greater centralization and correction of federal health activities by placing it "under the direction of a competent trained official who shall have the rank at least of an assistant secretary." This goes to President Coolidge and appropriate congressional committees.

Perhaps the newsiest resolution was that calling for the repeal of state laws and city ordinances interfering with window ventilation of schools by fresh untreated outdoor air admitted at the windows with gravity exhaust ducts for removing vitiated air from near the ceiling. This method being called the most satisfactory method. Ozone and other chemical treatment and as large volume of air as 30 cu.ft. per capita generally accompanied by overheating

(*Continued on p.* 730)

Three More Proposals to Develop Power on the Colorado

The board of directors of state institutions for Arizona have applied to the Federal Power Commission for a preliminary permit for a development on the Colorado River at the Bridge Canyon site in Mohave County, Ariz. It is proposed to erect a rock fill or concrete dam, to be so constructed as to make possible an ultimate height of 1,000 ft. Such a dam will develop 1,000,000 hp., it is estimated. The purpose of the improvement is to impound water for irrigation, to reduce flood danger, to provide power for pumping and other purposes and for marketing, and to provide water free from silt.

Fred T. Colter, of Phoenix, Ariz., on behalf of the state of Arizona, has asked for a preliminary permit covering a storage dam in Glen Canyon and a diversion dam at Bridge Canyon. No explanation is made in the application as to the conflict with the above application filed by the state for rights at Bridge Canyon only.

The City of Los Angeles some time ago applied to the commission for a preliminary permit covering a project on the Colorado River in San Bernadino County, Colo., and Yuma and Mohave County, Arizona. The project is in the vicinity of Parker, Ariz., and Needles, Colo. The plan provides for the storage of some 600,000 acre-ft. in a reservoir near Parker, where a head of 90 ft. can be obtained. The amount of primary power which will be made available is estimated at 108,000 hp.

Power Commissioners Appointed by Three States

The governors of the states of New York, New Jersey and Pennsylvania have appointed commissioners to represent their respective states on a joint commission to study the transmission and control of electric power in interstate movements within the limits of the three states. New York is to be represented by William A. Prendergast, chairman of the Public Service Commission, George R. Lunn, one of the commissioners, and Charles R. Vanneman, chief engineer of the commission. New Jersey is to be represented by Dr. Charles Browne, a member of Board of Public Utilities Commissioners, Robert F. Ingle, a former member of the State Board of Commerce and Navigation, and Isaac Alpern, president of the Perth Amboy Trust Co. The Pennsylvania representatives are Philip P. Wells, chairman of the Giant Power Survey Board, Clyde L. King, a member of the board and Morris L. Cooke its consulting engineer.

Engineers Employment Service Started at Chicago

The Engineering Societies Employment Service, under the direction of the four founder societies and the Western Society of Engineers, has opened an office in Chicago for the service of the members of the societies under whose direction it has been established.

Plans for Power Plant on Osage River Near Completion

Plans of the Missouri Hydro-Electric Co. for the construction of a dam and hydro-electric power development on the Osage River, near Bagnell, Mo., have been completed and the start of work now depends upon the issue of a license by the Federal Power Commission. The plans call for the construction of a dam 140 ft. high and 2,450 ft. long to form a reservoir extending 127 miles upstream and covering an area of about 100 sq. miles. The primary power of the site is estimated at 20,000 hp. in the Federal Power Commission report but it is stated now that five 33,000-hp. units will be installed.

A preliminary permit covering this site was issued to Walter Cravens in October, 1924. A new company, to be known as the Superpower Corporation of Missouri, with Mr. Cravens at the head, is being organized to carry on the development of the site.

Public Health Association Meets at St. Louis

(*Continued from p. 729*)

to avoid drafts, were condemned and many such systems called a waste of hundreds of thousand of dollars annually.

Creation and adoption of a simple standard milk ordinance adapted to many different sizes and types of communities was promulgated since the present non-uniformity leads to conflict of producers and health department with resulting lack of confidence.

In the laboratory section, Prof. E. O. Jordan announced the completion of the last edition of standard methods of water analysis put out jointly with the American Water Works Association. This marks at last co-operation of the members of the two great organizations using most standard laboratory methods.

Two sessions were held by the saintary section with C. M. Baker presiding, both chairman and vice-chairman being absent. Committees were named on standards and ventilation and one to co-operate with the Association of State Highway Officials on uniform signs with reference to roadside water supplies.

Subjects taken up by the section of the more general engineering nature were mosquito control illustrated by an excellent paper by A. F. Dappert, assistant sanitary engineer of Illinois State Health Department.

Highway water supplies came in for extended discussion by E. L. Waterman, professor of sanitary engineering, University of Iowa; W. H. Dittoe, sanitary engineer, Ohio State Board of Health, and H. F. Ferguson, sanitary engineer, Illinois State Board of Health.

Mr. Dittoe in the report of the committee on water supply and purification pointed out that the fundamental improvements in recent designs of filters has come about from information obtained on the operation of plants rather than the testing station of 20 to 25 years ago. It was suggested in cloak-room discussion that to this fact may be attributed the reason that the medical fraternity has concluded that the sanitary engineer has stopped research. The report calls attention to the increasing pollution of the streams and to the higher standards of purity demanded, both of which leads to the necessity for a better equipped personnel in operation. Various states are meeting the problems by schools where the operator is taught, as in Texas, or by conference when the operators furnish their own programs as in Ohio. New Jersey licenses operators in an attempt to raise the standard of efficiency of its operators. Discussion led to the designer's duty in the way of tuning up the plant and teaching operating personnel how to run the plant. Mr. Fuller indicated that his office kept a man for that purpose alone whose knowledge thus gained had proved valuable in future designs. Dana E. Kepner, sanitary engineer, Colorado State Health Department, said a bill requiring consultants to operate plants for six months after completion was introduced into the state legislature but failed of passage.

Twelve basic principles covering the design, construction and operation of municipal refuse incinerators were presented as the progress report of the committee on refuse collection and disposal by the chairman, C. A. Holmquist, sanitary engineer, New York State Board of Health. While not specifications the principles are a guide to city officials and engineers who do not specialize in refuse disposal. This work is the outcome of the symposium last year on model incinerator specifications and contract tests.

The committee on sewage and sewage disposal, which was headed by the late Prof. George H. Whipple, is still working on definitions. Mr. Whipple's compilation completed just before his death has been taken and joint action with a like committee of the Sanitary Division of the American Society of Civil Engineers is now under way.

Progress in the use of sewage sludge as a fertilizer was reported by a committee on the subject headed by Langdon Pearse, sanitary engineer, Sanitary District of Chicago. Houston gets $22.50 for small amounts produced at the Calumet and Maywood plants. Milwaukee is about to start producing 100 tons per day. Problems of dewatering still need much research, states the report, but considerable progress has been made in digestion of sludge in two-story tank, separate tanks or with screenings as at Indianapolis.

Newly elected officers of the sanitary section are as follows: Chairman, Abel Wolman; vice-chairman, W. L. Stevenson; secretary, A. E. Gorman, Chicago Board of Health; section council, Langdon Pearse, H. A. Whittaker and W. H. Dittoe. The national body elected Prof. C. E. A. Winslow as president; Dr. John A. Amyot, Dr. Max C. Stackloff and Dr. A. J. Chesley as vice-presidents; Dr. Louis I. Dublin, treasurer. Next year's meeting will be held at Buffalo.

Asphalt Paving Men Hold a Successful Convention

Day Labor Discussed—Excellent Program of Technical Papers—Over 200 Delegates

Action against day-labor construction was taken by formal resolution at Detroit last week by the conference on concrete roads held under the auspices of the Asphalt Association. The resolution included with a number of others of perfunctory nature was objected to as soon as a vote was asked on the report of the resolutions committee. A motion to strike the resolution from the report was lost after discussion in which the committee stood by its action. Motion was then made and carried that this resolution be lifted out from the others and acted on separately. In the discussion which followed the opposition urged mainly that the conference had no business dealing with construction policies but only with the technique of construction and that such a resolution was direct criticism of many members who were employing day-labor methods. In favor of the resolution it was argued that the time had come to call a halt in the further extension by public bodies of competition with private industry as socialistic and a fraud against the taxpayers. Very rarely, it was stated, was there an accurate and complete cost accounting of work done by day labor, and the public was led to believe that partial cost figures represented the full burden of expense it had to bear. Any gain in efficiency and quality was denied. Instead there was laxness of inspection and variation of specifications to a degree ranging from complete neglect to only fair observance. It was pointed out that the resolution definitely cited maintenance as properly a day-labor operation and also granted that under special conditions new construction could best be done by force-account methods. While the discussion was prolonged it brought out no additional argument and when vote was taken the resolution was adopted by a large majority.

In its technical work the conference carried through the most complete program of papers and discussions of any of its four annual meetings. Between 200 and 300 delegates were registered of which more than half were street and road engineers, road contractors and ashpalt technologists and the remainder represented asphalt paving equipment and they for the most part came from the technical staffs of the concerns represented and not from the sales organizations. There was strict exclusion of sales and propaganda talk from the program. This was divided into five main subjects: (1) Black base construction (2) resurfacing old streets (3) surface treatment of gravel and macadam roads (4) asphalt tests and (5) maintenance of asphalt pavements.

Black Base

In Denver, it was stated by city engineer A. K. Vickery, about 500,000 sq.yd. of black base have been laid on a sandy loam subbase with entire success. The prepared subgrade is covered with 3 in. of broken stone which is spread and sealed with loam about 85 per cent sand. On this is put 2½ in. of black base and a 1½-in. sheet asphalt top. This pavement is costing about $2.40 a square yard. In Pittsburgh black base was being used successfully, according to J. D. Strain, superintendent of streets for both heavy and light traffic streets in depths up to 12 in. The mixture was about 69 per cent crushed slag from 1½ in. to dust, 22 per cent sand and 6 per cent asphalt. A 1½-in. top was used. These streets were carrying in some instances the heaviest traffic of the city. On old stone block 3 to 4 in. of black base and a 1½-in. top was giving good satisfaction. Discussion by W. B. Chalmers of Grand Rapids, Mich., to be abstracted in our issue of next week, and by D. B. Coleman of Cortland, N. Y., cited further successful use of black base. In Cortland a steel plant slag was used and the pavements laid 3½ and 1½ in. on gravel and 4½ and 1½ in. on clay. The question of bridging service cuts came up for considerable attention. It was mostly agreed that in such cases the best practice was to bridge with a concrete slab but a number asserted that well-put-in black base was sufficient.

Resurfacing

The subjects of resurfacing and surface treatments brought out seven useful papers which have been reserved for separate abstract in the issue for next week. These papers were: Salvaging Gravel Roads, by G. C. Dillman, chief engineer Michigan Highway Department; Resurfacing Gravel at Grand Rapids, by C. A. Paige, city engineer; Resurfacing Paved Streets at Columbus, Ohio, by R. H. Simpson, city engineer; Resurfacing Macadam at Rockford, Ill., by B. C. Harvey, city engineer; Reconditioning Macadam for Resurfacing, by W. H. Woodward, superintendent of paving, Springfield, Mass., and Surface Treating Gravel Roads, by J. T. Bullen, engineer Caddo Parish, Louisiana. Mr. Woodward's and Mr. Harvey's papers also discussed surface treatment of macadam. These papers went into details of costs and methods and together form a symposium which deserves study in our next week's issue.

Maintenance

Maintenance was discussed specifically in papers by R. H. Simpson, city engineer of Columbus, Ohio, and by Hugh W. Skidmore, Chicago Paving Laboratory. The data given by Mr. Simpson were substantially those of his article in *Engineering News-Record*, July 23, 1925, p. 140. Methods of repairing service cuts, waves, broken base and cracks were described by Mr. Skidmore. Care and engineering supervision of repairs were urged. In repairing cracks the paper said: Most cracks in asphalt pavements are duplications of those in the base, particularly if the base is portland cement concrete. There is but one really satisfactory method of repairing cracks and that is to keep them filled with asphalt cement. The cracks should be cleaned out thoroughly and then blown out with air pressure (this can be done by means of a small air compressor, or cylinders of air under pressure) then the crack poured full of hot asphalt of regular paving consistency. A ridge of asphalt will remain on the surface of the pavement, this should be covered with limestone filler or portland cement while the A. C. is still hot and then ironed in with hot smoothing irons. It will be found that this method is much more satisfactory than the same treatment without the use of filler. All such work should be done in the early spring or fall when the cracks are at maximum width. Mild winter weather is an ideal time.

Asphalt Testing

The two papers under this heading were by Prevost Hubbard on stability tests and by W. J. Emmons on paving plant inspection. The paper by Mr. Hubbard extended the results of the series of tests described by him in *Engineering News-Record* Nov. 27, 1924, p. 862. A particularly notable conclusion of the more developed tests is that "stability is almost directly proportional to initial compression at least up to 3,000 lb." Mr. Emmons urged rigid inspection of plant operation and outlined methods. He said: There are several good reasons why competent inspection is essential and should be provided for in the specifications. The contractor is ordinarily a contractor only and not a paving technologist. He is primarily interested in the operation of his plant and in sustained maximum production. He desires quality certainly, but he also is eager to make a profit and his interests are inherently opposed to many of the refinements which are essential to best results. Perhaps the continued existence in some localities of the maintenance clause is in recognition of these facts. If so, it is certainly a less scientific, uneconomic and uncertain method of attempting to insure satisfactory construction.

Attorney General of New York Defines High Water Line

The attorney general of New York has handed down an opinion as to what constitutes the "high water line" along the state's tidal waterways and ocean water front which is of unusual importance. "The high water line, as a tidal boundary between privately owned upland and land washed by tide waters as to which there is a public trust or in which the public has so-called common law rights," means, according to the attorney general's ruling, "the line of ordinary mean high water and not the line of semi-monthly spring tide. Such a line is generally evident by the limit to which upland vegetation survives or would survive except for the presence and action of the water." Heretofore there has been uncertainty as to whether the state's title embraced the portion of land between the limits of the mean high tide and the much greater area ordinarily flowed by the semi-monthly high tide known as the spring tide.

Bridge and Building Men Meet at Buffalo

Buildings and Water Service Receive Most Attention—Metal and Wood Sash Discussed

Railway buildings and water service were the main subjects of consideration at the 35th annual meeting of the American Railway Bridge & Building Association, held at Buffalo, N. Y., on Oct. 20 to 22. Of special interest was a report on the numerous and varied uses of precast concrete units presented by T. H. Strate, engineer of track elevation, Chicago, Milwaukee & St. Paul Ry. These uses range from bridge and trestle spans to large and small buildings, and to such articles as poles, water troughs and track signs. Monolithic concrete as applied to signal cabins, stations, highway bridges over tracks and such monumental structures as the Tunkannock Viaduct, was dealt with in entertaining illustrated addresses by Geo. J. Ray, chief engineer of the Delaware, Lackawanna & Western R.R. A paper by H. Ibsen, special bridge engineer of the Michigan Central R.R., described the erection of the new steel arch bridge at Niagara Falls.

Water Treatment

The treatment of water for locomotive use, as an important factor in economy of operation, was discussed in a paper by R. C. Bardwell, superintendent of water supply of the Chesapeake & Ohio Ry., who pointed out that in addition to tangible economies in cost of boiler cleaning and repairing there are still more important intangible economies, such as the reduction in engine failures and train delays. This subject was supplemented by a report on electric pumping plants for railway water stations. The need of stand-by or auxiliary plants was noted by Mr. Knowles, Illinois Central R.R., who cited cases where electric storms had destroyed the transformer connections and put the pump motors out of commission. Some doubt was expressed as to the reliability of automatic control, but Mr. Knowles is of the opinion that devices now available may be considered as absolutely reliable.

Metal and Wood Sash

In the discussion of a report on metal and wood sash, some objection was made to the former on the score of maintenance expense due to more frequent painting, particularly in engine-houses, and also to adjustment of ventilating or movable sash. Wood sash that gets out of plumb and does not work properly is easily adjusted, but in some cases with metal sash the only remedy was to file away the metal until the sash would close, leaving only a thin shell. It was pointed out also that the present tendency to provide larger area of sash for increased light results in greater maintenance expense for broken glass. The bridge and building department has to handle the maintenance and repair, while other departments determine the type of sash to be used. Steel sash had its supporters, however, and Mr. Baluss, engineer of the Duluth, Messabe & Northern R.R., referred to a building in which wood sash required renewal in seven years while steel sash in the same building was then in good condition. As to glazing, one member has found roofing cement preferable to putty.

Sand-blast for cleaning and the spray system for painting were recommended in a report on the protection of structural steel, but this report was accepted only as information and referred back to the committee for further consideration. The same fate attended reports on the use of creosoted timber and the use of various kinds of roofing, as it was held that these reports were too general in character. All the subjects were discussed, however, and it was suggested that the committees in question give particular attention to points suggested in the discussion.

C. W. Wright, Long Island R.R., was elected president; C. A. Lichty, Chicago & Northwestern Ry., Chicago, was re-elected as secretary. A good "side-show" of the meeting was an exhibit of materials and appliances for railway bridge and building work.

Indiana Revokes Engineering License of Architect

Following a three-day hearing, the Indiana State Board of Registration for Professional Engineers and Land Surveyors has revoked the Indiana license of Harry Weeks, a member of the architectural firm of Walker & Weeks, of Cleveland, Ohio. The firm has under design the $5,000,000 Indiana war memorial plaza and buildings which will house Indiana patriotic societies and national headquarters for the American Legion. The license of F. R. Walker, the other member of the firm, was not revoked.

The action followed a hearing on charges of misconduct in preparation of the plans for the memorial. These charges were that the designs for the memorial included details of steel reinforcement for the concrete which illustrated and specified a certain product of the Rivet Grip Steel Co., a corporation in which the two members of the firm have an interest and of which they are officers. The charges further stated that the details were so given that no other form of reinforcement could be estimated upon.

The unanimous vote of five members of the board revoked the license of Weeks and three members voted to revoke the license of Walker. The state law provides that four votes are necessary for the revocation of licenses. The board made the distinction between the two members of the firm because two members of the board felt that the real responsibility for the specifications lay with Mr. Weeks. In the testimony before the board, H. Tashjian, chief engineer of the firm and president of the Rivet Grip Steel Co., assumed full responsibility for the part of the specifications relating to the reinforcement.

Mr. Weeks has announced that he will appeal from the decision of the board to the Circuit Court of the State.

Random Lines

Don't Crowd

Every bird who tries to reform the world wants to call himself a human engineer these days—that is when he isn't a social engineer. Lawyers, ministers, social workers, efficiency experts—they're all human engineers. Indeed they are organized; they call themselves the "Pathfinders of America" and they are announcing a drive for members to aid in the campaign for $100,000 to further the work of teaching human engineering in the schools.

* * *

What Does He Do?

Mary Roberts Rinehart, who ought to know better, says in her latest Saturday Evening Post story that out in the wide open spaces a man has to be "a hydrostatic engineer of sorts."

* * *

Telling the Lay Public

A lot of people, especially those addicted to the tabloid newspaper literary style, want to know more about the huge tidal power plant they are proposing to build up where Maine and New Brunswick come together. All is made clear by a recent statement of W. S. Murray, the New York consulting engineer. An article by him says of the promoter of the plan:

> He has pointed out a potentiality hitherto hidden from the mind of men—namely that it took the conjoint relation of differing water levels and particular land configuration to produce the power men have dreamed of harnessing ever since they noted the sea's tremendous, restless, but regular energy.

There you have all the excellence of literary style—clarity, restraint, verity, simplicity. Why don't more engineers write?

* * *

More Geophysics

The Canadian scientist who was afraid that possibly the depletion of the Great Lakes by Chicago might be causing all these earthquakes has his match in the colored minister reported, as follows, in "Wayside Tales."

> "Breddern and sisters, we have received annuder warnin of Providence. De earf, breddern, revolutes on its axles, an' it takes a right sma't ob grease to keep it lubricated. So de good Lord put petroleum inside de earf to keep de axles greased.
>
> "Den, bye an' bye, long come all dese hyah ile companies, punchin' holes in de ground clear down into de bearin's, and quensecontly all de ile come squirtin' out. Fust thing we know dere's a hot box an' de earf squeaks an' rumbles an' grunts an' dat's de earfquake. If dey don't quit it purty soon dere won't be no moah grease left, an' de earf will stick tight on its axles an' won't go round no moah."

New Map of Southeastern States Shows Power Plants and Lines

A map of the Southeastern States has been prepared by the Division of Water Resources of the State of North Carolina for the Southern Appalachian Power Conference which shows the location of all power transmission lines, their voltage, and the location and size for all power plants, both steam and hydro-electric, including the location of small isolated power plants in the area. The map has been printed by the United States Geological Survey to a scale of 1:1,000,000 and is being issued by the Division of Water Resources, State of North Carolina, Chapel Hill, N. C. The price of the map is $3 each for lots of less than 50, with special rates for larger quantities.

The map now being issued is marked preliminary, and it is expected that a revision will be published within a year.

New Technical Societies

The *Engineering News-Record* list of technical societies and national engineering trade associations of the United States and Canada is being revised. Societies and associations which have been organized since the original list was published in 1923 or which were not included in that list should send in their name with the secretary's name and address, the date of their annual meeting and their total membership.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Convention, Grand Rapids, Mich., Nov. 17-19, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C., Annual Meeting of the Highway Research Board, Washington, D. C., Dec. 3-4, 1925.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 11-15, 1926.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Toronto, Ont., Jan. 27-29, 1926.

The American Society of Mechanical Engineers will hold its annual meeting at New York, Nov. 30 to Dec. 4.

The National Municipal League will hold its 31st annual meeting in conjunction with the 21st annual meeting of the American Civic Association at Pittsburgh, Pa., Nov. 18 and 19.

The Central States Section of the American Water Works Association held its twenty-seventh annual convention at Erie, Pa., Oct. 9 and 10 and elected the following officers: President, Joseph W. Ellms; vice-president, Chester Drake; and trustees, D. C. Grobbel and Mentor Hetzer.

The Council of State Boards of Engineering Examiners will hold its sixth annual convention at the Columbia Club, Indianapolis, Ind., Nov. 16 and 17. Topics for discussion include use of application blanks for reciprocal registration; interpretation of articles of agreement; why an engineer should apply for registration; how far legislation has protected the public and the profession; prosecutions; and jurisdiction. T. Keith Legare, Columbia, S. C., is secretary-treasurer.

The North Carolina Section of the American Water Works Association meeting at Asheville, Sept. 14, 15 and 16 elected the following officers: President, J. O. Craig; vice-president, M'Keen Maffitt; and secretary and treasurer, Thorndike Saville, Chapel Hill, N. C.

Personal Notes

A. G. PATTERSON, president of the Alabama Public Service Commission, was elected president of the National Association of Railroad and Utilities Commissioners at its recent meeting at Washington, D. C.

MELVILLE DOZIER, JR., has been appointed manager of the Southern California chapter of the Associated General Contractors of America succeeding E. Earl Glass, who resigned to become manager of the Pacific Coast Sand & Gravel Association. Mr. Dozier has been manager of the construction industries joint committee since its organization last year.

JOHN C. PRITCHARD, assistant engineer, supply and purifying division, St. Louis Water Department, has been made water commissioner, the position which E. E. WALL held until he was recently made director of public utilities. Mr. Pritchard is a native of St. Louis and a graduate of Washington University in the class of 1904. He has been with the water department since 1909.

WALLACE R. HARRIS for 6½ years managing editor of *Highway Engineer and Contractor* and of *Concrete Products* has resigned to assume the position of sales manager for the Eberling Machine Sales Co., Cleveland, makers of equipment for manufacture of concrete building units. He will have offices at 1,248 Peoples Gas Building, Chicago. Mr. Harris was the first president of the Concrete Products Association, is a member of the Engineering Institute of Canada, Western Society of Engineers and second vice-president of the American Association of Engineers. Immediately prior to becoming an editor Mr. Harris was engineer of the Cement Products Bureau, Portland Cement Association after seven years' experience in the prairie provinces of Canada embracing general engineering and construction, manufacture of concrete pipe, operation of gravel pits and consultant on engineering problems for municipalities and construction companies.

Obituary

WILLIAM PERKINS BIRNIE, for five years associated with his father, William Birnie, in the firm of Goodhue & Birnie, builders of railroads and city and town water systems and prominent in that line of activity in New England some 40 years ago, died in his home in Springfield, Mass., Oct. 17, at the age of 75.

DR. EARLE JAY BABCOCK, dean of the College of Engineering of the University of North Dakota, died suddenly Sept. 3, 1925, at the age of 60. He was graduated from the University of Minnesota in 1889, began work at once on the faculty of the above university, first in chemistry and geology, which changed with the growth of the institution until it now covers industrial chemistry, mining and metallurgy. He was the first state geologist, from 1897 to 1902. In 1917-18 he was acting president of the University. Development of the natural resources of the state in different lines of chemistry and geology, were largely due to him and were brought out by his research and investigation, particularly in the manufacture and use of natural cements, lignite coals and pottery clays. PROF. E. F. CHANDLER has been made acting dean.

HUGH L. LUCAS, for seventeen years superintendent of the Chicago water pipe extension bureau, died suddenly Oct. 20. He was a member of the American Water Works Association and the Western Society of Engineers.

CURTIS HILL, former Missouri state highway engineer, died at his home in Kansas City, Mo., Oct. 18, in the 55th year of his age. Mr. Hill was born in Independence, Mo., and received his civil engineering degree from Cornell University in 1897. Previous to graduation he was employed in railroad work and subsequent to graduation continued in railroad work for some years. From 1900 to 1901 he was first on highway bridge work and then on survey work at the Louisiana Purchase Exposition. In 1901 he went to the sewer department of St. Louis, becoming engineer for the department in 1903, which position he occupied when he was appointed state highway engineer. In 1913 he was made city engineer of Kansas City, Mo., and served under three city administrations. In 1918 Mr. Hill was shot by a road contractor at Kansas City and never fully recovered from the injury received.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Caution in Using Compressed Gas Cylinders

The Interstate Commerce Commission has prescribed certain regulations for the manufacture and testing of cylinders used in transporting gases compressed to pressures over 25 lb. per sq.in. Among these are the requirement that the cylinders be tested periodically as to safety and that the date of test be stamped on the cylinder as "10-25" for Oct., 1925.

The Bureau of Explosives of the American Railway Association in cooperation with the Compressed Gas Manufacturers' Association warns users that they should observe these markings and notify the owners of any cylinders which are overdue for tests as based upon the following test-period table for various gases:

Name of Gas	Intervals at Which Cylinders Should Be Tested
Acetylene	Once—before putting in service
Anhydrous Ammonia	Every 10 years
Carbonic Gas	Every 5 years
Chlorine	Every 5 years
Ethylene	Every 5 years
Helium	Every 5 years
Hydrogen	Every 5 years
Hydrocarbon gases (other than Acetylene)	Every 5 years
Methyl Chloride	Every 5 years
Nitrous Oxide	Every 5 years
Oxygen	Every 5 years
Sulphur Dioxide	Every 5 years

Business Notes

J. G. White Engineering Corp., New York City, has recently received a contract from the Firestone Plantations Co. for the building of a breakwater, wharves, roads and other work incident to the development of the harbor of Monrovia, the capital and principal city of Liberia. The work is in connection with the plan of Harvey S. Firestone, president of the Firestone Tire & Rubber Co., to develop Liberia as a source of rubber supply. It is said that the Firestone interests will invest $100,000,000 in developing its rubber concession in Liberia and plans to have eventually 1,000,000 acres of rubber trees growing on what is at present wild country.

J. T. Tractor Co., Cleveland, Ohio, announces the following new dealers: W. J. Armstrong Co., Sault Ste Marie, Mich.; Bangor Mill Supply Co., Bangor, Maine; Alan G. Cary & Co., St. Paul, Minn.; Joe Lyons Machinery Co., Little Rock, Ark.

Robert June engineering management organization of Detroit has acquired control of the Electric Flow Meter Co., Kansas City, Mo., formerly the Hyperbo-Electric Flow Meter Co., Chicago, and will henceforth operate the business under its own management with executive offices in Detroit. The officers of the new company will be Robert June, president; J. M. Naiman, vice-president and chief engineer; and Maj. W. W. Burden, treasurer.

The Duriron Co., Inc., Dayton, Ohio, announces the appointment of John C. Candler, 315 Glenn Building, Atlanta, Ga., as a representative of its building equipment department to cover the state of Georgia.

Chicago Pneumatic Tool Co., New York City, has effected arrangements with Motoren-Werke, Mannheim, Germany, whereby it has acquired the exclusive rights to manufacture and sell the Benz solid-injection Diesel engine in the United States and Canada. This engine is of the vertical, multiple-cylinder type, built on the four-stroke principle.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., announces the appointment of Edward D. Kilburn and Walter S. Rugg as vice-presidents. Mr. Kilburn was formerly vice-president and general manager of the Westinghouse Electric International Co. and will now take charge of the engineering work of the Westinghouse Co. at Pittsburgh. Mr. Rugg who was formerly general sales manager of the Westinghouse Co., will have charge of the sales activities. Richard B. Mellon, president of the Mellon National Bank of Pittsburgh, has been elected a director of the company, to fill the vacancy caused by the death of William McConway, formerly president, McConway & Torley Co.

Massillon Steel Joist Co., Massillon, Ohio, has taken over the management of the Canton Bridge Co., Canton, Ohio. The Canton Bridge Co. will continue in its operation as a structural steel fabricating shop in addition to producing the products of the Massillon Steel Joist Co. The home office of the Massillon Steel Joist Co. has been moved to the plant of the Canton Bridge Co. and the officers and department heads will function for both organizations. The address of the Massillon Steel Joist Co. hereafter will be 10th & Belden, N. E., Canton, Ohio.

Climax Engineering Co., Clinton, Iowa, announces the appointment of the Coast Machinery Corp., San Francisco, as sales representatives covering the entire state of California. Ed. Crowley, recently general sales manager of the Climax Engineering Co., is the president of the Coast Machinery Corp. Other appointments of new dealers by the Climax company are: George W. Whitehead Co., Buffalo, for Western New York; Edward C. Dingman, Montreal, Canada, for Montreal and vicinity; Harvard Turnbull & Co., Ltd., Toronto, for Ontario; Advance Contractor Repair Co., Chicago, for the Chicago territory; Mine & Smelter Supply Co., Salt Lake City, for Utah.

Foundation Co., New York City, in order to give more effective control of its growing construction activities, has decided to divide its field of work into four zones as follows: The United States, Central and South America, where activities will be controlled by the New York company; Canada by the Foundation Co., Ltd.; the British Empire, exclusive of Canada, by the Associated British Co.; the remainder of the world will be the fourth zone, including Europe, Asia and Africa exclusive of British territory; a new company will operate in this proposed fourth zone. The Foundation Co. of New York, the parent, will hold the controlling interest in the common stock of this new company. The business of the Foundation Co. is now carried on in fourteen countries and eight others are being surveyed for potential business.

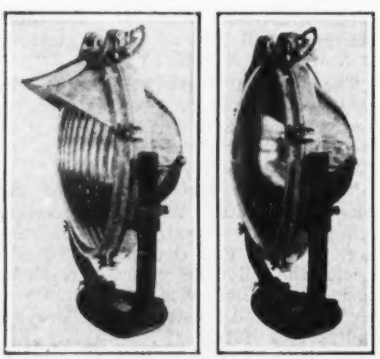
The Engineering and Sales Co., San Francisco, announces a change of address, effective Oct. 1, from 200 Davis St. to 24 California St., Marvin Building.

Wm. H. Ziegler Co., Inc., with offices in Minneapolis, St. Paul and Duluth, has been appointed distributor for the Caterpillar Tractor Co. in the state of Minnesota.

Equipment and Materials

Ventilation Unnecessary in New 23-in. Floodlight Projector

By providing a sufficient radiating surface to insure safe interior temperatures for the glass reflector and lamp, the Pyle-National Co., Chicago,



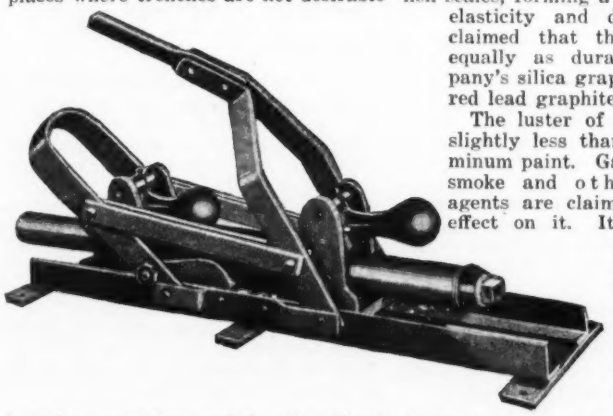
has designed a floodlight projector in which ventilation has been entirely dispensed with. The cast aluminum alloy case has an absolutely tight inclosure

with machined surfaces at the door joint and a soft lead packing ring; small parts are of aluminum and bronze. The tight case eliminates depreciation in reflective values that is caused by dust, gases, moisture and insects.

The mounting base and trunnions are provided with locking devices so that adjustment of the unit is not disturbed by the maintainer. Focusing is effected from outside the case. Crystal glass reflectors 23 in. in diameter are used together with rectangular divergence lenses which make the projector exceptionally powerful. Lamps of 1,000 and 1,500 watts are used in this equipment.

Pipe Pusher Eliminates Necessity of Digging Shallow Trenches

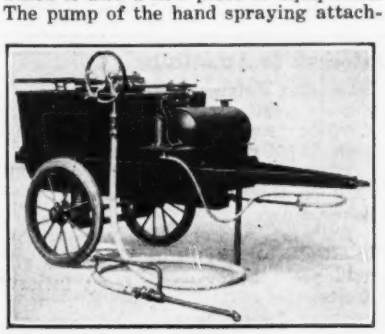
A machine designed to eliminate digging across lawns, highways and other places where trenches are not desirable



is being manufactured by the Giant Mfg. Co., Council Bluffs, Iowa. It is a one-man machine, its pushing power being derived from the application of compound leverage. It is easily staked down and is claimed to eliminate all possibility of bending the pipe since it operates close to the bank. The machine releases the pipe automatically after each forward thrust. Its speed capacity is about 3 lengths of pipe per hour.

Small Hand Spraying Device for Road Maintenance

A hand sprayer that makes it possible to apply hot bitumen to the road in much the same manner as the larger distributors is manufactured by Littleford Bros., Cincinnati, Ohio. In the accompanying illustration, this attachment is shown installed on the company's oil burning melting kettle No. 84-W, which is also a new piece of equipment. The pump of the hand spraying attachment is mounted on a wholly adjustable frame which makes it adaptable for all types and sizes of heating kettles. A large flexible metallic hose is used in connection with the spray bar, which is held by the operator and in the end of which is an adjustable spray tip.



New Aluminum Graphite Paint Makes Durable Surface

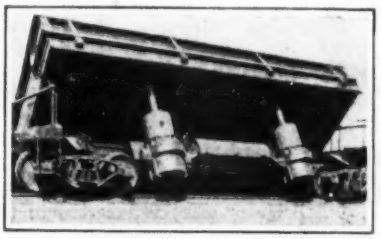
The new aluminum graphite paint that the Joseph Dixon Crucible Co., Jersey City, N. J., has recently announced as an addition to its line, is composed of aluminum combined with flake silica-graphite pigment and boiled linseed oil. Aluminum when used for paint making is of flake formation and when combined with the pigment, each flake laps over, after the manner of fish scales, forming a covering of great elasticity and durability. It is claimed that this new paint is equally as durable as the company's silica graphite paint and its red lead graphite primer.

The luster of the new paint is slightly less than a straight aluminum paint. Gases, fumes, acids, smoke and other deteriorating agents are claimed to have little effect on it. It is claimed that it will retain its color longer than other light colored paints and will reflect light and heat in such a manner as to make it of great value as an industrial paint. The paint can be sprayed or brushed on, although the latter method is recommended. It is especially recommended for all exposed metal work such as gasholders, oil tanks, and refrigerator and tank cars.

Quick-Dumping Cars Discharge Material Away From Track

Low height, the placing of material an extreme distance from the track, and the elimination of any locking mechanism are the distinctive features of the new air dump cars manufactured by the Differential Steel Car Co., Findlay, Ohio. The low height, 7 ft. 4 in. from top of rail to top of sideboard, gives stability and easy loading. The dumping force is furnished by four air cylinders arranged in pairs. In dumping to the right, the air valve is turned so that the air is fed into the cylinders on the left side of the car. By the action of these cylinders, the body is tilted about trunnions over the bolster side bearings on the right. The door, which is also the side of the car, folds down while the body tilts and it returns in a reverse manner. There is sufficient reservoir capacity for air on each car to dump it. All sizes of material can be dumped to either side without changing cylinders or any other mechanism.

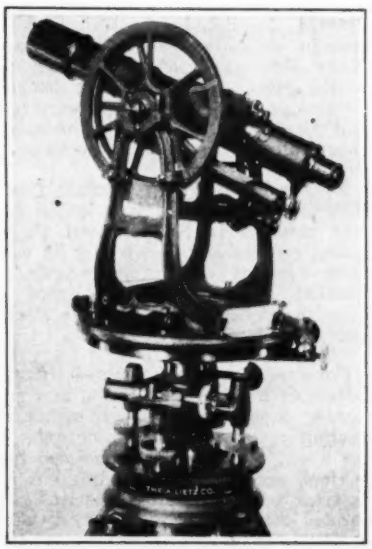
The down-folding door places the load clear of the track and holds it there. The sector plate construction on the ends of the door forms a chute which prevents the material from falling over the ends of the doors and fouling the ballast. The maximum angle of the car while dumping is about 50 deg. which allows clean dumping of even



very sticky clay. The termination of the dumping operation is cushioned so that there is no damage to the car, track structure, or trestles. This type of car permits a train of cars to be dumped to either side from any car in the train. This air-dump car is furnished in 30- and 24-yd. capacities.

Substantial Transit Is a New Western Product

Lateral rigidity in the upper structure of transits is very essential and to this end the A. Lietz Co., San Francisco, has designed its new Theodolite No. 5E. The U-shaped telescope support consists of a one piece casting with a large circular base which is rigidly attached to the upper plate. Inside of this base is installed the compass equipped with a variation ring and a 3½-in. needle. The section shape of the



telescope support is an "even cross" which gives great stability with a minimum of material and weight.

The transit is equipped with a 6¼-in. horizontal circle and a 5-in. vertical circle both with double verniers reading to minutes. The telescope is 11 in. long and employs a magnifying power of 24 times; stadia hairs are set 1:100. The compass needle is 3½ in. long and the object glass 1¼ in. in dia. The weight of the instrument is 15½ lb. and the tripod weighs 8 lb. additional.

Publications from the Construction Industry

Surveying Instruments—L. BERGER & SONS, INC., Boston, Mass., has just published the 40th edition of its general catalog on transits, levels and other instruments of precision. The catalog contains 190 pp. describing the details of each model and size of instrument. The customary indexes and code lists complete the catalog. A price list dated Aug. 1, 1925, is inserted in the catalog.

Concrete Pipe—LOCK JOINT PIPE CO., Ampere, N. J., has just issued a new 80-p. catalog describing its concrete pipe. The first part of the booklet is devoted to design details of the pipe, followed by a description of the manufacturing processes used in making poured pipe, cylinder pipe, and centrifugal pipe. This part of the booklet is especially well illustrated with photos showing the pipe in process of manufacture. The last 30 pp. of the catalog are devoted exclusively to photos of construction work, in which Lock Joint pipe is being used.

Aerial Tramways—A. LESCHEN & SONS ROPE CO., St. Louis, Mo., in its catalog No. T-25, describes its system of aerial tramways. A section of the catalog is devoted to general information concerning the adaptability and operation of aerial tramways and telling of their design and manufacture. The greater part of the catalog is devoted to detailed descriptions of specific installations of tramways. Many illustrations are used which add to the practical value of this booklet. Several pages are devoted to wire rope and wire rope fittings and all necessary data are listed for ordering purposes.

Excavadoras—HARNISCHFEGER CORP., Milwaukee, Wis., has just issued two new catalogs in Spanish and Portuguese, respectively, describing its complete line of excavating machinery. Catalog No. 601-S is published in Spanish, while No. 602-P is the Portuguese catalog.

Construction Locomotives—HEISLER LOCOMOTIVE WORKS, Erie, Pa., in a new catalog, shows a wide variety of quarry hauling operations by photographs of the work. The booklet is divided into sections according to the different industries served. These sections are devoted respectively to quarry hauling products, sand and gravel operations, and strip-pit mining. The booklet further contains comparative records of different methods of haulage used on both large and small operations.

Concrete Pavement—AMERICAN VIBROLITHIC CORP., Des Moines, Iowa, devotes a new booklet to the construction operations used in laying vibrolithic pavement. Several photographs are given showing examples of this pavement both under construction and in service.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Some Demands on Material Markets By Building Contracts Let This Week

FOLLOWING are the values of certain special materials and items involved in this week's building contracts published on pp. 251 to 256 of Construction News. They include awards of industrial buildings to cost $40,000 and more and of other buildings, $150,000 up.

Paint	**$258,000**	**Hardware**	**$221,000**
Glass	**370,000**	**Elevators**	**1,470,000**
Roofings	**296,000**	**Electric wiring**	**530,000**
Flooring (est.)	**5,350,000 sq.ft.**	**Lighting fixtures**	**482,000**

Where Markets for Roofing Materials Are Most Promising

ROOFING materials, for buildings other than residential, evidently find their best market in the Middle Atlantic States, according to figures compiled by *Engineering News-Record.*

As the accompanying illustration shows, 39 per cent of the total value of all roofings of this character was expended in the section mentioned during the first nine months of this year.

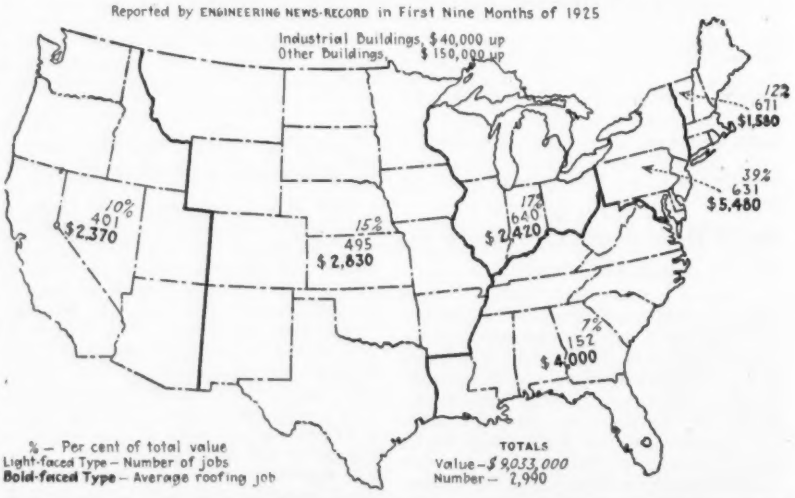
The South was also a good market, with the states immediately west of the Mississippi following and the Great Lakes section fourth. This, however, merely shows what has happened in the sale of this particular material.

An examination of proposed work, as published in *Engineering News-Record* at the minimum mentioned in the chart, gives a clear idea of the prospects in this field for the next two months at least.

November will undoubtedly witness the greatest activity in the Middle West, with the South next and the Middle Atlantic states third.

December of this year, according to work in the projected stage as late as September, will show activity in roofing sales centered in the section embracing New York, Pennsylvania, New Jersey, Delaware and Maryland.

Value of Roofings Required for the Building Contracts



Foreign Projects of Interest to Americans

For further information see the Bureau of Foreign and Domestic Commerce, where reference number is given.

Dredging, breakwaters, etc., Alexandria, Egypt, under consideration by Council of Ministers of the Egyptian Government, approximately $7,500,000.

Railroad, Rouyn Gold Fields, Canada, 44.7 mi., tenders called, total cost, $2,500,000 to $3,000,000. Reserved Information Reference No. 184334.

New public works for Province of Cordoba, Argentine, bids to be taken soon, 727,791 pesos (peso = $0.92).

Paving, water and drainage system, City of Guatemala, Guatemala, plans being drawn.

Railroad and public improvements in Chile, investment of 2,100,000 gold pesos authorized by Presidential decree.

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
October 29, 1925	$22,064,000	$26,970,000	$49,034,000
October 22, 1925	21,468,000	31,088,000	52,556,000
October 30, 1924	25,313,000	21,448,000	46,761,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to Date			
1925	906,367,000	1,227,346,000	2,133,713,000
1924	855,544,000	878,556,000	1,734,100,000

Unit Prices on Camden-Philadelphia Bridge

FOLLOWING are the lowest three bids opened by Delaware River Bridge Joint Commission, Philadelphia, June 17, for Philadelphia Approach, 5th to 6th Sts., and work in adjacent streets, for bridge over Delaware River connecting Philadelphia and Camden. Contr. No. 22. (A) Acchione & Canuso Paving Co., 804 South 12th St., (awarded contract); (B) Mazzola & Marano; (C) Frederick Snare Corporation. The unit bids are as follows:

	A	B	C
50,000 cu.yd. excavation for structures	$1.40	$1.50	$1.30
7,000 cu.yd. borrow excavation	1.50	1.00	1.10
50 cu.yd. trench excavation	3.00	5.00	6.00
5,000 cu.yd. concrete masonry, grade A, 2 inch aggregate	21.00	18.00	18.00
1,600 cu.yd. concrete masonry, grade A, ¾ in. aggregate	22.75	20.00	18.00
1,200 cu.yd. concrete masonry, grade B	15.75	14.50	18.00
300 cu.yd. concrete masonry, grade C	14.00	11.00	17.00
5,900 cu.yd. concrete base for roadway paving and repaving	2.30	10.00	9.00
180,000 lb. reinforcing steel	.059	.05	.05
203,000 lb. reinforcing steel for roadway base	.049	.05	.05
7,300 sq.yd. waterproofing	1.38	1.45	1.40
900 sq.yd. damp-proofing	.28	.30	.40
66 hundred sq.ft. roofing felt	4.50	5.00	6.00
2,700,000 lb. structural steel	.05	.047	.053
66,000 ft. b.m. timber bulkhead	96.00	100.00	110.00
Granite masonry (lump sum)	180,250.00	.....	198,000.00
177 lin.ft. lock joint granite curbing	9.64	10.00	10.00
378 lin.ft. 17½ in. granite curbing	7.00	8.70	7.50
2,200 lin.ft. 8 in. straight granite curbing	3.50	3.75	4.00
1,420 lin.ft. 8 in. curved granite curbing	4.00	4.50	4.50
Light and ornamental metalwork (lump sum)	31,787.00	32,835.00	35,000.00
Electrical conduit system (lump sum)	5,600.00	8,000.00	7,000.00
550 lin.ft. 8 in. concrete coping	1.50	1.50	1.20
280 lin.ft. 3 in. concrete coping	.80	.35	.60
4 concrete posts in Franklin Square	12.00	25.00	30.00
100 cu.yd. rubble masonry retaining walls	7.83	15.00	12.00
20 cu.yd. dry rubble walls	6.75	7.00	10.00
10 cu.yd. brick masonry	28.45	30.00	40.00
21,000 sq.yd. new granite block paving	6.40	5.60	5.80
1,960 sq.yd. redressed stone block paving	2.25	2.10	2.30
3,880 sq.yd. stone block repaving	2.25	1.35	1.20
10,000 sq.yd. concrete sidewalks	2.50	2.25	2.80
800 sq.ft. ½ in. premoulded expansion joint filler	.20	.25	.25
2,500 sq.ft. ½ in. premoulded expansion joint filler	.13	.20	.24
640 sq.yd. slate flagging	6.10	5.00	5.00
810 sq.yd. crushed stone walks	.70	1.10	1.00
830 lin.ft. resetting curbing	.75	.75	.40
2,200 lin.ft. removing, hauling and stacking old curbing	.50	1.00	.50
1,260 sq.yd. repaving flagstone sidewalk	1.00	1.00	1.00
5,500 sq.yd. new sodding	1.00	.70	1.00
2,200 sq.yd. resodding	.50	.60	1.00
1,370 sq.yd. top oil	1.00	.70	2.00
280 lin.ft. galvanized pipe handrailing	3.25	3.25	3.00
643 lin.ft. 4 ft. diameter brick sewer in concrete cradle	52.00	55.00	75.00
3,255 lin.ft., 4 to 24-in., vitrified clay sewer pipe	10.31	6.18	10.90
190 lin.ft. 12 in. cast iron water pipe	7.50	5.00	7.00
40 lin.ft. 8 in. cast iron soil pipe	2.00	2.00	2.50
30 lin.ft. 6 in. cast iron soil pipe	1.75	1.50	2.50
6 brick manholes with covers and frames	200.00	200.00	350.00
2 brick wellholes	350.00	400.00	1,100.00
2 No. 2 brick and stone inlets	175.00	200.00	200.00
12 No. 3 brick and stone inlets	160.00	150.00	200.00
8 No. 4 brick and stone inlets	90.00	125.00	125.00
Two, special double inlets (lump sum)	500.00	800.00	1,600.00
2 cesspools	30.00	40.00	15.00
Piping and fixtures for water supply (lump sum)	4,070.00	2,700.00	4,000.00
20 cu.yd. rubble (French) drains	6.00	5.00	3.00
Extended totals	$930,314	$932,296	$980,955

Winter Building Gains from Year to Year

E. N.-R. Records Show Consistent Increase In Lettings Since 1920—Benefits To Builders Outlined

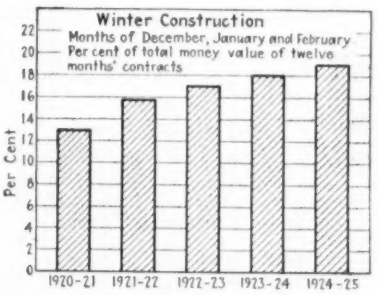
A steady increase in the amount of work done during the coldest months of the year, (December, January and February) has been evident since 1920, according to figures for the entire country compiled by *Engineering News-Record.*

WINTER CONTRACT TOTALS

	1920-21 (Thousand)	1921-22 (Thousand)	1922-23 (Thousand)
December	$138,792	$309,954	$304,869
January	160,791	239,465	331,985
February	149,018	229,022	322,609
Winter	$448,601	$778,441	$959,463

	1923-24 (Thousand)	1924-25 (Thousand)
December	$369,396	$415,844
January	385,178	397,778
February	376,581	381,224
Winter	$1,131,155	$1,194,846

Minimum costs observed in these calculations are: water-works and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial and other buildings, $150,000.



According to the New York Building Congress the direct benefits to the builder to be derived from winter construction are as follows:

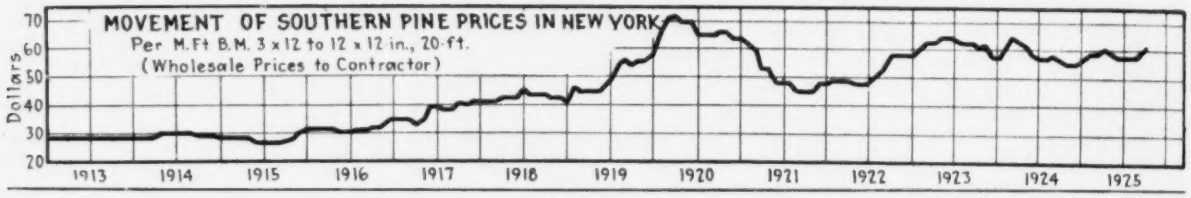
1. Direct additional costs arising from construction carried on during cold weather are only a small percentage of the total cost of a building.
2. All direct winter costs are easily offset by savings in other ways.
3. These conditions cover the building scale at least to operations as low as $100,000.

Indirect benefits, offsetting winter costs are as follows:

1. Labor bonuses are eliminated.
2. Labor turnover is reduced.
3. Spreading the overhead expenses of contractors throughout the entire year greatly reduces organization and equipment costs.
4. Tendency of contractors to lower the margin of profit with the idea in mind of securing sufficient work to keep their organizations intact during the winter months.
5. Seasonal discounts for materials.
6. Special rates by transportation companies, thus helping to relieve the congested periods.
7. A saving of interest and taxes on investments which would otherwise be idle.
8. Quicker returns from investments.

Weekly Construction Market

THE two most important price changes of the week occurred in cement and coke. Following a drop of 10c. per bbl. at the mills, portland cement declined 20c. per bbl. in Toledo and Detroit and 10c. per bbl. in Pittsburgh, Chicago and nine other Midwestern cities. This is the first change of note since January, 1925, and brings the current market on this material back to the level prevailing at the beginning of the year. Furnace coke rose $4.75 and foundry, $4.50 per ton at Connellsville, between Oct. 16 and 23. The abnormal coke demand for domestic use, while it has tightened the supply for the iron industry, has not yet caused a general upward movement in pig-iron prices. While iron buying is in good volume, the fact that few orders are for first quarter (1926) delivery would lend a serious aspect to both the iron and the steel markets. The following chart shows the movement in long-leaf yellow pine timbers at New York, over a period of thirteen years. Since January, 1923, the price has hovered around $60 per M. ft. b.m., delivered to job.



	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	$4.00	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb.	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	2.80	3.00	3.25	3.77½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	—55%	53.6%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	+49.50	54.00	49.20@50.20	53.00	63.00	53.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.25	2.05	—2.10	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	2.20	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.65	2.00	2.00@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.20	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	34.00	60.00	53.50	35.75	33.75	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000.	—17.50@18.50	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1027	.0893	.10	.075	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	—1.00½	—1.10	1.13	1.01	1.11	1.23	1.15	1.12	1.25
Common Labor									
Common labor, union, hour	.55@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93⅞c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 1, the next on November 5.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5¼ x 8 x 12¼. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 101.187). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

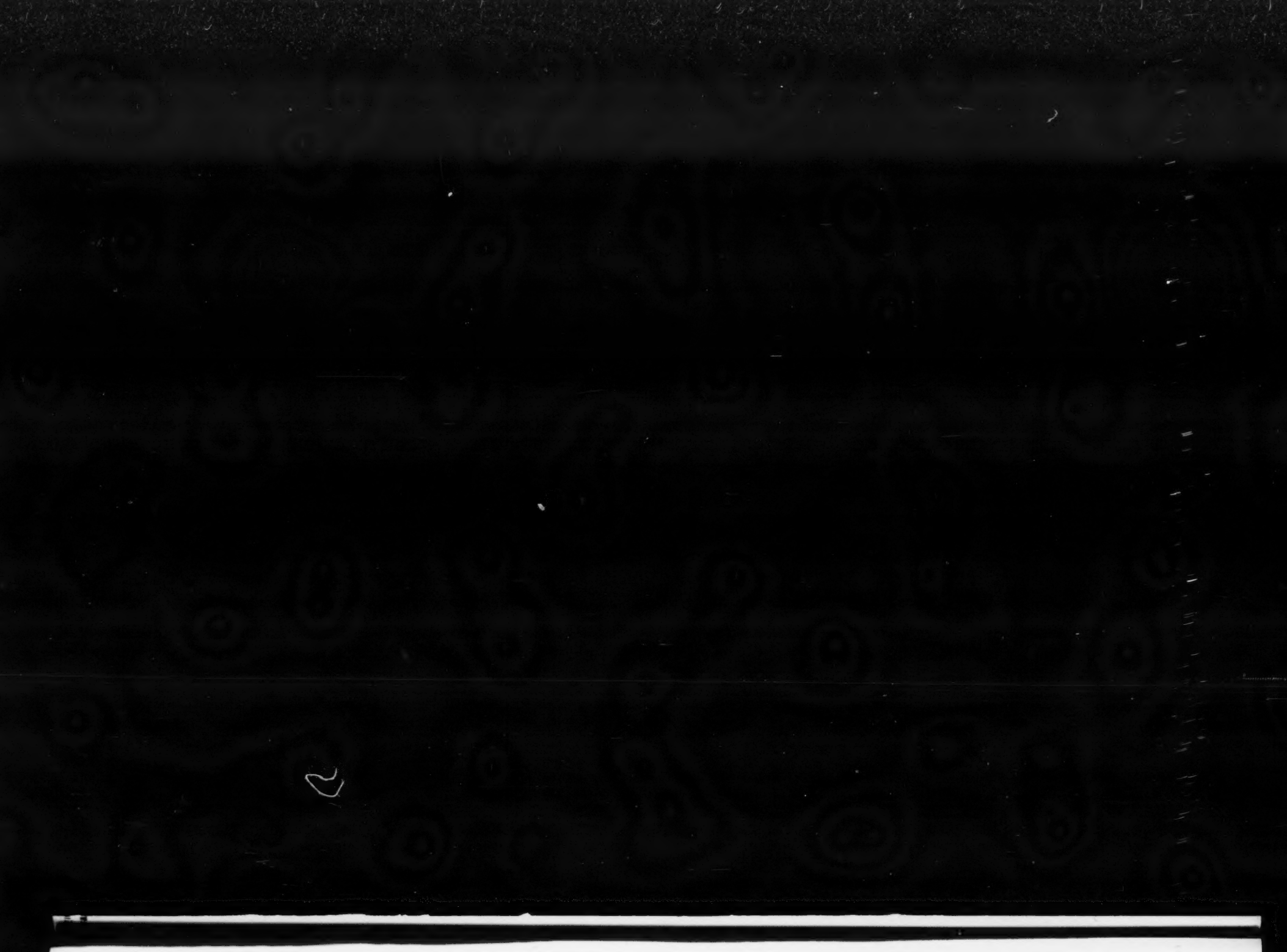
Call Money quoted at 4½@5 per cent, Oct. 26; year ago, 3 per cent.

Time loans: short terms, 4¾@5 per cent; longer periods, 5 per cent.

Commercial paper: best names, 4½ per cent; other names, 4¾ per cent.

On October 1, 1925

E. N.-R. Construction Cost Index Number 205.35

E. N.-R. Construction Volume Index Number 262

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month